southeast minnesota tributaries basin report

a resource plan

APRIL 1980

SOUTHEAST MINNESOTA TRIBUTARIES BASIN REPORT

Prepared by

U. S. Department of Agriculture
Soil Conservation Service
Economics, Statistics, and Cooperatives Service
Forest Service

In Cooperation With The
Southern Minnesota Rivers Basin Board

April 1980

SOUTHEAST MINNESOTA TRIBUTARIES BASIN

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Southeast Minnesota Tributaries Basin

January 1980

DISCOUNT RATE COMPARISON
SOUTHEAST MINNESOTA TRIBUTARIES BASIN

This addendum was prepared to show the effects 7-1/8 percent interest rate and the Water Resources Council's current normalized prices (1979) will have on the cost and return of the Selected Plan. The Selected Plan was originally evaluated using 6-5/8 percent interest rate.

Effects resulting from this evaluation are shown for the National Economic Development account and the Regional Development account. The effects on the Environmental Quality and Social Well-Being account are not shown in this addendum because there will be only minimal changes vs. the 6-5/8 percent interest rate.

Addendum to Selected Plan
National Economic Development Account
Southeast Minnesota Tributaries Basin

Components Beneficial Effects:	Measure of Effects (Average Annual $) 1/	Components Adverse Effects:	Measure of Effects (Average Annual $) 2/
The value to users of increased outputs of goods and services.		The value of resources required for a plan.	
Added return from agricultural production from land treatment systems		Land Treatment Cost 3/	
Cropland	1,065,000	Cropland	1,322,000
Pastureland	272,000	Pastureland	9,300
Forest Land	-1,016,000	Forest Land	306,100
Total	321,000	Total	1,637,400
Total Beneficial Effects	321,000	Total Adverse Effects	1,637,400
		Net Effect	-1,316,400

1/ Adjusted to reflect WRC 1979 normalized prices.
2/ 7-1/8% interest rate for 10 year period.
3/ Includes $81,900 for Operation and Maintenance.

Addendum to Selected Plan
Regional Development Account
Southeast Minnesota Tributaries Basin

Components	Measure of Effects	
	Minnesota	Rest of Nation
Income:	(Average Annual $) 1/	
Beneficial Effects:		
The value of increased output to users residing in the region.		
Added value of agricultural production from land treatment systems.		
Cropland	1,065,000	-
Pastureland	272,000	-
Forest Land	-1,016,000	-
Total	321,000	-
Total Beneficial Effects	321,000	-

Components	Measure of Effects	
	Minnesota	Rest of Nation
Income:	(Average Annual $) 1/	
Adverse Effects:		
The value of resources contributed from within the region to achieve the output.		
Land Treatment		
Installation	736,830	900,570
Subtotal	736,830	900,570
Total Adverse Effects	736,830	900,570
Net Effects	-415,830	-900,510

1/ 7-1/8% interest rate. Adjusted to reflect WRC 1979 normalized prices.
2/ Cost amortized at 7-1/8 percent interest rate for ten year evaluation period.

PREFACE

The Southeast Minnesota Tributaries Basin (SEMT) study was made under the authority of Section 6 of the Watershed Protection and Flood Prevention Act of the 83rd Congress (Public Law 566, as amended). This act gives the Secretary of Agriculture the authority to cooperate with other federal, state, and local agencies in their investigation of river basin, watersheds, and waterways to develop coordinated plans and programs. The Secretary of Agriculture designated the Soil Conservation Service (SCS) to provide leadership in carrying out the United States Department of Agriculture's responsibilities in conducting the study. The Economics, Statistics and Cooperatives Services (ESCS), and the Forest Service (FS) participated under provisions of a Memorandum of Understanding dated April 15, 1968, (RB Memorandum-2), Rev., dated May 6, 1968).

In 1971 the Agricultural Appropriation Act provided funds for the United States Department of Agriculture to cooperate with the State of Minnesota in studies of the southern Minnesota rivers basin. The southern Minnesota rivers basin includes the Minnesota River Basin and the tributaries of the Mississippi River in Minnesota which enter downstream from the mouth of the Minnesota River (henceforth designated as the Southeast Minnesota Tributaries Basin). These cooperative river basin studies resulted from two requests to the Soil Conservation Service by the State Soil and Water Conservation Commission (now the State Soil and Water Conservation Board). A request was submitted to study the Minnesota River Basin and the Southeast Minnesota Tributaries Basin in November, 1967, and January, 1969, respectively. The study of the Minnesota River Basin was completed and a report was published in February 1977.

This study is sponsored by the State Soil and Water Conservation Board. During the 1971 Minnesota Legislative Session, the Southern Minnesota Rivers Basin Board (SMRBB) was created and charged with developing and implementing a comprehensive environmental conservation and development plan for the basin. The SMRBB worked with the USDA throughout the study. They established a policy committee in the basin to obtain local input and guidance, and sponsored a series of public meetings and tours.

This study was initiated to:

1. Identify the present and projected water and related land resource problems.

2. Provide information and data for the statewide Comprehensive Water Management Plan.

3. Identify project opportunities and provide a basis for establishing project priorities.

4. Allow for an orderly installation of developments, based on urgency of need, that will meet the water and related land resource needs and promote social and economic improvement in keeping with overall objectives.

In addition to the agencies actively participating in this study, appreciation is hereby expressed to the following agencies for their cooperation and assistance:

U.S. Department of Agriculture

Science and Education Administration
Agricultural Stabilization and Conservation Service
Farmers Home Administration

U.S. Department of the Interior

Heritage Conservation and Recreation Service
Fish and Wildlife Service
U.S. Geological Survey

Others

Soil and Water Conservation Districts
University of Minnesota
County Governmental Officials
Local Residents and Community Organizations
Region 10 Regional Development Commission (Southeastern Minnesota)
Region 10 Water Quality Advisory Committee

U.S. Department of Defense

Army Corps of Engineers

State Agencies

Minnesota Water Planning Board
Minnesota Department of Natural Resources
Minnesota Pollution Control Agency
Minnesota Department of Economic Development
Minnesota State Planning Agency
Minnesota Historical Society
Minnesota Soil and Water Conservation Board
Minnesota Department of Revenue
Minnesota Department of Health
Minnesota Geological Survey
Minnesota Crop and Livestock Reporting Service
Water Resources Board

SUMMARY

The Southeast Minnesota Tributaries Basin includes about 6,091 square miles and covers parts or all of the following counties: Blue Earth, Dakota, Dodge, Fillmore, Freeborn, Goodhue, Houston, Le Sueur, Mower, Olmsted, Rice, Scott, Steele, Waseca, Wabasha, and Winona. The basin drains into the Mississippi River by way of three major rivers, the Cannon, Root, and Zumbro, and a network of smaller tributaries. The basin population was 441,330 in 1970 and is projected to be 672,600 by the year 2000.

Present land use within the basin is shown in the following table.

Table 1 Present Land Use

Southeast Minnesota Tributaries Basin

Land Use	Area (Acres)	Area (Percent)
Cropland	2,414,640	62
Pastureland	364,910	9
Forest Land	609,960	15
Other Land	235,690	6
Urban & Built-Up	183,850	5
Federal Non-Cropland	24,970	1
Water Area	64,620	2
Total Area	3,898,640	100

Nine problems or concerns associated with the basin's water and related land resources were identified by local citizens and state agencies. These concerns and their order of importance are as follows:

1. Erosion and Sedimentation - Approximately 2,386,990 acres of cropland, pastureland, and forest land are subject to erosion hazards. Over 16.4 million tons of soil are lost annually from these acres. Sediment delivered to streams and lakes are estimated at one million tons annually. Erosion is a problem on 600 miles of streambank.

2. Water Pollution - Surface and ground waters are being polluted at an alarming rate. Ground water is being polluted from pollutants entering sinkholes, abandoned wells, quarries, and gravel pits. A major source of pollution is surface runoff from agricultural fields. Other sources are from various agricultural chemicals, urban discharges, and feedlot runoff.

3. Conflicting Land Uses - Unplanned development caused by scattered uncontrolled residential, commercial, and industrial developments in agricultural and unique areas is causing loss of prime agricultural land, conflicts between development and preservation of natural areas, adverse environmental effects, and high cost for providing services.

4. Poor Condition of the Forest Resource - The poor condition of the forest land has resulted in accelerated erosion, and low production. In its present condition the forest provides only minimal watershed protection and timber growth is approximately forty percent of its potential.

5. Wet Agricultural Soils - Approximately 394,120 acres of agricultural lands have a wetness condition that interferes with land preparation, tillage, plant development, and harvest operations.

6. Flooding - The one hundred year flood affects approximately 97,000 acres in the basin. Agricultural areas subject to annual flooding are primarily in pasture, forest, or wildlife land use and are thus subject to relatively low cash loss.

7. Loss of Fish and Wildlife Habitat - Major problems are continued loss of habitat to other land uses and deteriorating quality of remaining habitat.

8. Inadequate Recreation Opportunities - The lack of recreation facilities to meet present and projected demand is the major problem associated with recreation.

9. Inadequate Water Supply - Concern over water supply is primarily a problem of water quality. Water quality was expressed as a water pollution problem and was discussed in that section.

Several alternative kinds and levels of resource development were considered and a plan which was most acceptable for addressing the needs and objectives of the local people was selected. The selected plan places emphasis on accelerating conservation land treatment to reduce erosion and sediment on agricultural and forest land. It concentrates on treating the most critical erosion areas. The recommended land treatment practices for cropland include contouring, stripcropping, terrace, permanent cover, and other treatment such as reduced tillage, minimum tillage, and crop residue use. Practices to be installed on pastureland include re-establishment, brush control and pasture management. To install the level of land treatment on crop and pastureland that is recommended in the selected plan will require 15.8 additional man years per year. Woodland grazing control and tree planting are recommended on forest land.

Application of conservation land treatment on cropland, pastureland, forest land, and other land will reduce wind and water erosion and resulting sedimentation within and downstream from each watershed within the basin. This will result in more efficient use of land and water resources. A comparison of the effects on erosion and sedimentation by implementation of the selected plan with the future without plan is shown in Table 2.

The recommended conservation land treatment program will provide incidental benefits to fish and wildlife and recreation. The recommended plan enhances long-term agricultural productivity by protecting the soil resources and enhances water quality as a result of reduced erosion and sedimentation. The selected plan is recognized as being only the first step in addressing and solving the identified land and water related resource problems within the basin. Additional programs and strategies need to be developed and implemented to address some of the more complex issues such as water quality, conflicting land uses, and recreation opportunities.

Annual land treatment cost for the selected plan is $1.265 million, for cropland, $9,000 for pastureland, and $300,000 for forest land. Seventy percent of the erosive cropland soils, 49 percent of the pasture, and 53 percent of the forest land will be adequately protected by the year 2000. Erosion will be reduced by 19.7 percent from cropland, 36.4 percent from forest land and 10.0 percent from pastureland.

Table 2 Comparison of the Effects of the Selected Plan With the Future Without Plan - Year 2000 Southeast Minnesota Tributaries Basin

Problems and Concerns	Units	Present	Remaining Problem--2000 Without Plan	Remaining Problem--2000 With Plan
I. Erosion	Million Tons/Yr			
A. Cropland	"	13.6	10.5	8.5
B. Pastureland	"	1.5	1.3	1.2
C. Forest Land	"	1.3	1.1	0.7
II. Sediment Delivered to Lakes & Streams	"	1.0	0.8	0.7
III. Cropland Which Exceeds Erosion Tolerance Levels	Ac.	696,280	502,000	434,000

This report will be used to:

1. Assist decision makers in understanding the nature of existing problems pertaining to water and related land resources within the basin as identified and prioritized by local citizens.

2. Serve as a guide in coordinating water and related land resource development programs and projects of local, state and federal agencies, and private groups.

3. Aid in setting priorities for water resources development and management within the Southeast Minnesota Tributaries Basin.

4. Assist the USDA in making the most effective use of its land and water conservation development programs.

5. Help identify the potential for water quality plans and projects for southeast Minnesota.

6. Help justify continuation of Minnesota cost-sharing program and state legislature funding to achieve soil conservation objectives.

7. Help the Upper Mississippi River Basin Commission set development priorities and to develop coordinated plans for the Upper Mississippi Basin.

Components of the selected plan reflect preferences of groups and individuals in the planning areas. To achieve the level of development and environmental quality proposed, will require the cooperation of landowners and farm operators and additional assistance from all levels of government.

It is recommended that this plan be implemented to the degree possible through an acceleration of existing programs. Local governments and organizations should have primary responsibility in plan implementation. Technical expertise, financial assistance, and enabling legislation to ensure orderly and comprehensive implementation of the plan should be provided by the state and federal government. Those agencies and organizations that provide technical and financial assistance for land treatment measures should be involved in implementing this plan. These agencies and primary responsibilities include:

1. Soil Conservation Service - Technical Assistance

2. Agricultural Stabilization and Conservation Service - Cost-Sharing Program on Conservation Measures

3. USDA Forest Service - Technical Assistance

4. Farmers Home Administration - Loan Programs

5. Soil and Water Conservation District - State Cost-Share Program

6. Minnesota Department of Natural Resources - Technical and Financial Assistance.

Further research and studies are recommended to understand the relationships between land use activities and the quality of water resources and also to establish standards and needs for resource protection as related to those two problems. Educational programs are recommended to provide residents information about resource problems, their potential solutions, and the availability of assistance through various agencies and organizations.

CHAPTER I

RESOURCE BASE AND USE

Location

The Southeast Minnesota Tributaries Basin is located in the southeastern part of Minnesota (see Location Map). The basin drains into the Mississippi River by way of three major rivers, the Cannon (07040002), Root (07040008), and Zumbro (07040004) and several smaller streams (07040001-07040003-07040006). 1/

The basin drainage area includes 6,091 square miles and covers parts or all of the following counties: Blue Earth, Dakota, Dodge, Fillmore, Freeborn, Goodhue, Houston, LeSueur, Mower, Olmsted, Rice, Scott, Steele, Waseca, Wabasha, and Winona. Table I-1 shows the total area of each county and the percent and area of each county within the basin.

Rochester is the largest city in the basin with a 1975 population of 56,200. Other major cities in the basin are Winona, Owatonna, Faribault, Red Wing, Northfield, Hastings, and those cities located in northern Dakota County which form part of the Twin Cities metropolitan area.

Climate

The Southeast Minnesota Tributaries Basin has a continental climate. The basin is subject to occasional outbreaks of continental polar air throughout the year with frequent Artic

1/ Hydrologic units codes as established by member agencies of the United States Water Resources Council and the responsible water resource agency in each state.

TABLE I-1 Area by County

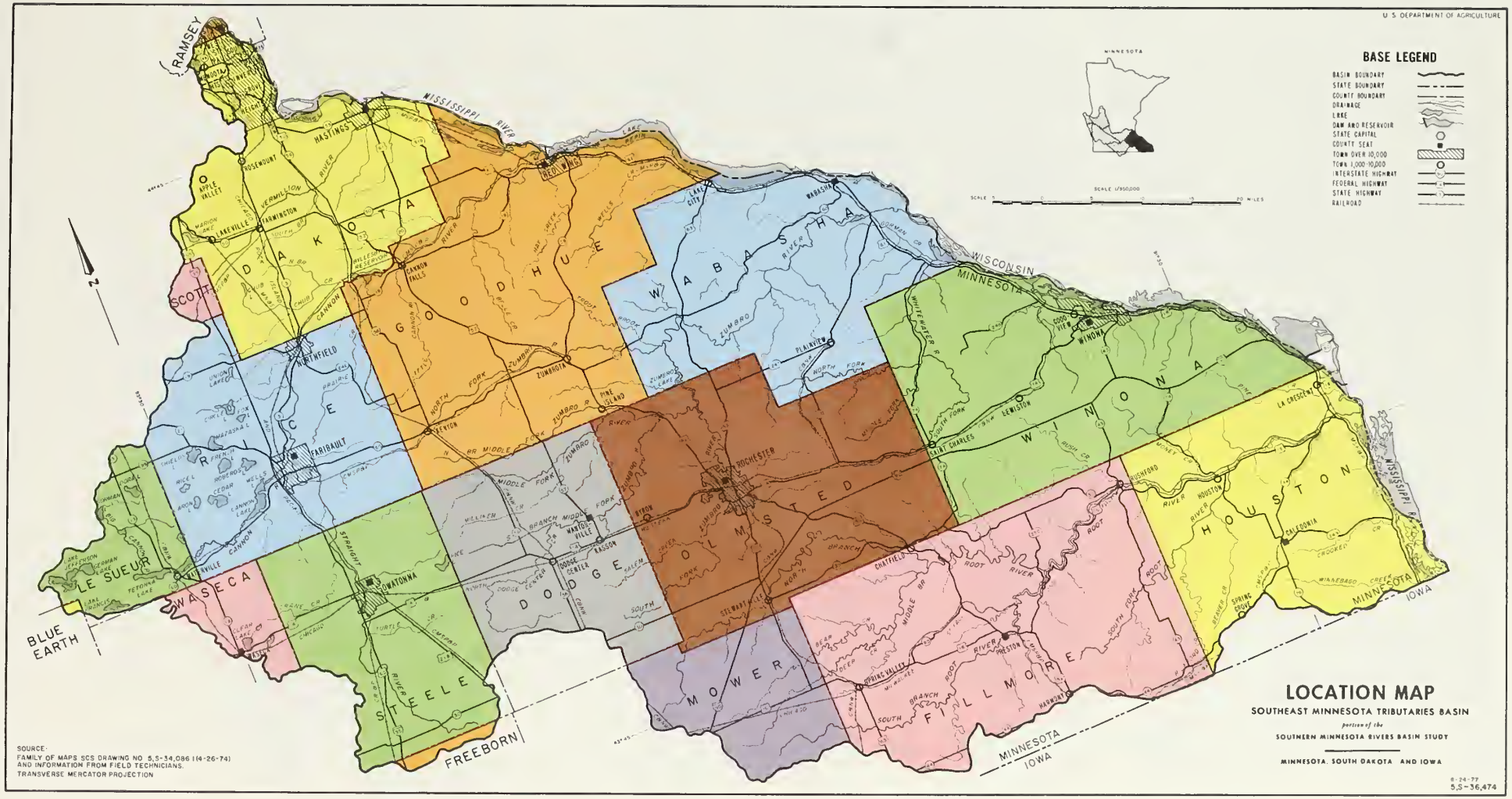
Southeast Minnesota Tributaries Basin

County	Total Area in County (Sq. Mi.)	Percent of County in SEMT	County Area in SEMT (Sq. Mi.)
Dakota	588	87.8	516
Scott	364	6.2	22
Blue Earth	753	.3	2
LeSueur	467	30.0	141
Waseca	425	19.1	81
Dodge	435	84.6	368
Fillmore	859	89.0	765
Freeborn	718	1.8	13
Goodhue	771	100.0	771
Houston	570	91.7	523
Mower	703	30.6	216
Olmsted	656	100.0	656
Rice	511	91.4	467
Steele	427	89.7	383
Wabasha	535	100.0	535
Winona	632	100.0	632
Total			6,091 1/

1/ Drainage area includes 0.3 square miles located in Allamakee County, Iowa.

outbreaks during the cold season. Occasional periods of prolonged heat occur during summer, particularly in the southern portion, when warm air pushes northward from the Gulf of Mexico and the southwestern United States. Pacific Ocean air masses that move across the western United States produce comparatively mild and dry weather in all seasons.

Temperature extremes range from about -40° F. to 108° F. January is the coldest month with an average normal temperature of about 13° F. July is the warmest month with an average normal temperature of about 70° F.


U.S. DEPARTMENT OF AGRICULTURE
BASE LEGEND
BASIN BOUNDARY
STATE BOUNDARY
COUNTY BOUNDARY
DRAINAGE
LAKE
DAM AND RESERVOIR
STATE CAPITAL
COUNTY SEAT
TOWN OVER 10,000
TOWN 1,000-10,000
INTERSTATE HIGHWAY
FEDERAL HIGHWAY
STATE HIGHWAY
RAILROAD
MINNESOTA
SCALE 1/950,000
SCALE 0 5 10 20 MILES
RAMSEY
SCOTT
DAKOTA
GOODHUE
WABASHA
WINONA
RICE
OLMSTED
HOUSTON
LE SUEUR
WASECA
DODGE
FILLMORE
MOWER
STEELE
BLUE EARTH
FREEBORN
WISCONSIN
MINNESOTA
IOWA
MISSISSIPPI RIVER
HASTINGS
ROSEMOUNT
APPLE VALLEY
LAKEVILLE
FARMINGTON
HERMITAGE
CANNON FALLS
RED WING
LAKE CITY
ZUMBROTA
PLAINVIEW
WINONA
LA CRESCENT
FARIBAULT
NORTHFIELD
ROCHESTER
BYRON
MANTORVILLE
DODGE CENTER
KASSON
OWATONNA
STEWARTVILLE
CHATFIELD
PRESTON
SPRING VALLEY
CALEDONIA
SPRING GROVE
NORTH FORK ZUMBRO RIVER
SOUTH FORK ZUMBRO RIVER
MIDDLE FORK ZUMBRO RIVER
ZUMBRO RIVER
CANNON RIVER
STRAIGHT RIVER
ROOT RIVER
MIDDLE BRANCH ROOT RIVER
SOUTH BRANCH ROOT RIVER
WHITEWATER RIVER
LEWISTON
SAINT CHARLES
HOUSTON
CROOKED CREEK
WINNEBAGO CREEK
SOURCE:
FAMILY OF MAPS SCS DRAWING NO. 5,S-34,086 (4-26-74)
AND INFORMATION FROM FIELD TECHNICIANS.
TRANSVERSE MERCATOR PROJECTION
LOCATION MAP
SOUTHEAST MINNESOTA TRIBUTARIES BASIN
portion of the
SOUTHERN MINNESOTA RIVERS BASIN STUDY
MINNESOTA, SOUTH DAKOTA AND IOWA
8-24-77
5,S-36,474
USDA-SCS-LINCOLN, NEBR. 1978

The freeze-free (air temperature greater than 32° F.) growing season generally starts about the second week of May and ends during the first week of October. The area in southeast Minnesota along the Mississippi River has the longest growing season in the State, approximately 160 days. For the most part, native vegetation grows for seven months (April through October), and row crops grow five months (May through September). Growing Degree Days (GDD) in the basin average near 2,700. (The GDD is derived from the excess of daily mean temperature over 50° F.; minimum temperature cannot fall below 50° F. nor maximum rise above 86° F. for computational purposes.)

The ground freezes about the first week of December and thaws in mid-April. Average maximum freeze depth ranges from three to four feet, exclusive of forested regions where the freezing depth is much less.

Mean annual precipitation is 32 inches in the extreme southeast corner of the basin and decreases to 29 inches in the northwest corner. Approximately two-thirds of the annual precipitation occurs during the five month (May through September) crop growing season.

Annual precipitation extremes for the basin range from 51.53 inches in 1911 at Grand Meadow in Mower County, to 11.65 inches in 1910 at Rochester in Olmsted County. At many locations, there have been months with no precipitation recorded. Statewide, two of the driest years on record were 1910 and 1936 while 1911 and 1965 were the wettest.

Conditions of moderate drought are expected at least once in four to five years. Severe drought conditions occur once in every eight to nine years. Generally, the more severe droughts tend to persist or recur several years in succession.

Geology and Topography

The basin has three major physiographic divisions, the Western Lake Section, the Dissected Till Plains, and the Wisconsin Driftless Section. The Western Lake Section consists of huge masses of glacial drift deposits. Most lakes in the section were formed by ice blocks deposited in the till. The Dissected Till Plain is located in the mid section of the basin and consist of zones of terminal moraines. The Wisconsin Driftless Section is located in the eastern portion. It was never covered by glacial debris but was affected by great volumes

of water pouring down from the melting glaciers cutting huge vertical gullies in the bedrock.

Westward from the Mississippi Valley is a region of numerous caves, sinkholes, and underground channels formed by the dissolving action of ground water on limestone formations near the surface. Such caves and sinkholes occur most frequently in the counties that were not covered by the most recent glacial drift. In the area where sinkholes abound, some of the roofs of the caverns have collapsed and an unusual type of land form has developed. This is referred to as "Karst topography" (see Potential Sinkhole Areas Map following page II-7).

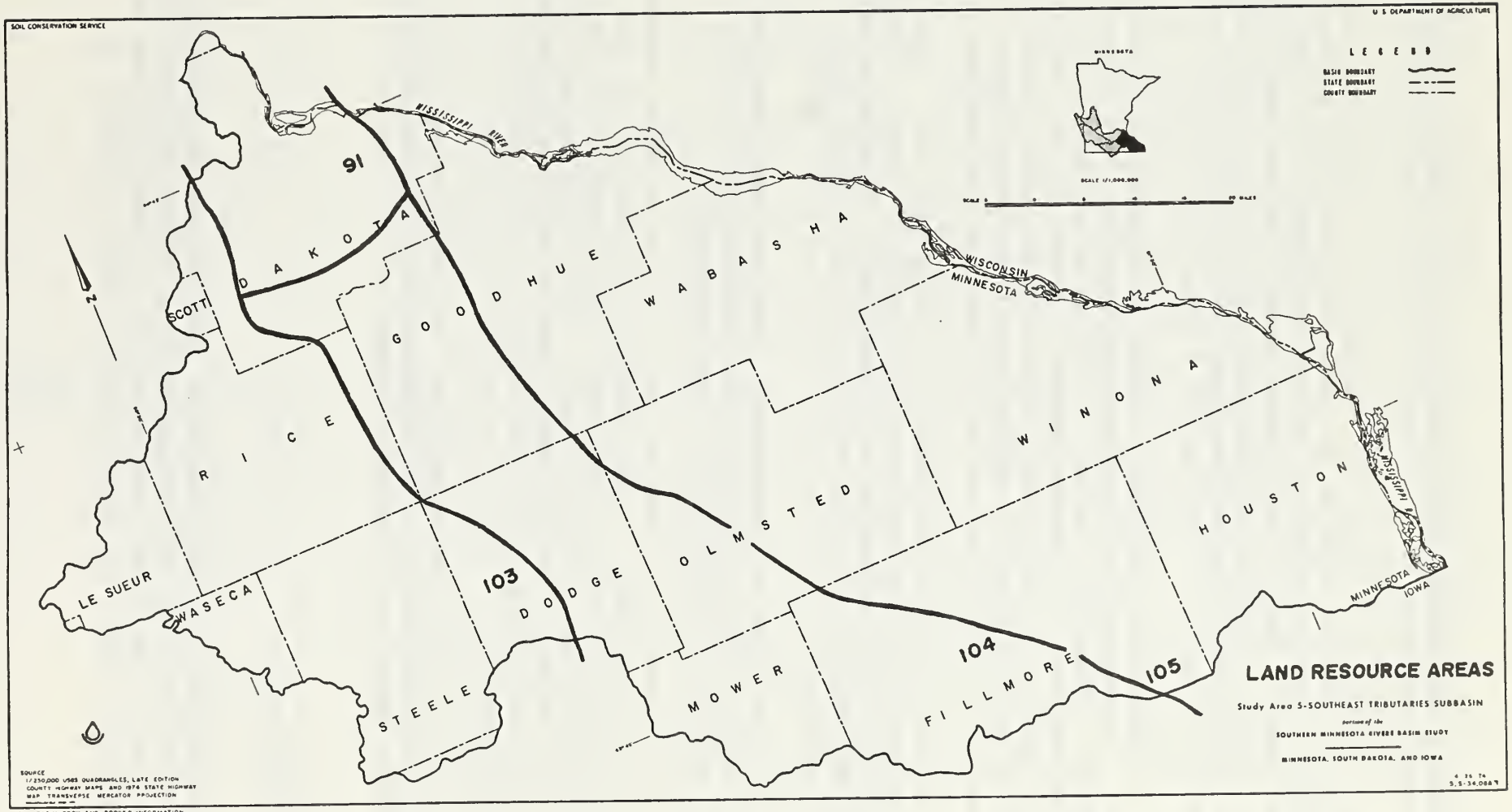
The sloping sides of sinkholes are steep and clifflike, and the area between sinks is eroded into a network of numerous short gullies and ravines which terminate abruptly where they discharge their waters into the subterranean channels. Where the openings of the sinks are clogged with soil and other debris, the water cannot descend to the channels below the surface but is ponded in the funnel-shaped depressions at the surface.

Land Resource Areas

The Southeast Minnesota Tributaries Basin is located within the Central Feed Grains and livestock Land Resource Region. This region is further broken down into Land Resource Areas (LRA). LRA's are broad geographic areas having similar soil, climatic, geologic, vegetative, and topographic features. The basin includes portions of four major LRA's: LRA 103 - Central Iowa and Minnesota Till Prairies, LRA 104 - Eastern Iowa and Minnesota Till Prairies, LRA 105 - Northern Mississippi Valley Loess Hills, and LRA 91 - Sandy Outwash (See Land Resource Areas Map).

The extreme western portion of the basin is in LRA 103. Nearly all the area is in farms. Corn, soybeans, and other feed grains are the major crops. Between 10 and 15 percent is permanent pasture of tame and native grasses. Narrow bands of woodland on steep slopes border stream valleys and some of the wet bottomlands are also forested.

Most of the soils in LRA 103 are deep, medium, and moderately fine-textured soils. Well and moderately well-drained soils (Clarion, Nicollet, Kilkenny, Lester, and LeSueur) occur on the nearly level to sloping uplands. Webster, Marna, Madelia,


U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
LEGEND
BASIN BOUNDARY
STATE BOUNDARY
COUNTY BOUNDARY
SCALE 1/1,000,000
SCALE 0 10 20 30 40 50 MILES
MINNESOTA
WISCONSIN
MINNESOTA
IOWA
MISSISSIPPI RIVER
MISSISSIPPI RIVER
91
103
104
105
DAKOTA
SCOTT
GOODHUE
WABASHA
WINONA
RICE
OLMSTED
HOUSTON
LE SUEUR
WASECA
DODGE
STEELE
MOWER
FILLMORE
N
LAND RESOURCE AREAS
Study Area 5-SOUTHEAST TRIBUTARIES SUBBASIN
portion of the
SOUTHERN MINNESOTA RIVERS BASIN STUDY
MINNESOTA, SOUTH DAKOTA, AND IOWA
SOURCE
1/250,000 USGS QUADRANGLES, LATE EDITION
COUNTY HIGHWAY MAPS AND 1976 STATE HIGHWAY
MAP TRANSVERSE MERCATOR PROJECTION
A BASIN BORY AND BORDER INFORMATION
B COUNTY AND STATE BOUNDARIES
C COUNTY AND STATE NAMES

Canisteo, and Lerdal soils occur on level and slightly depressed surfaces.

The west central portion of the basin is located in LRA 104. Nearly all of the area is in farms and about 80 percent is cropland. Corn, soybeans, other feed grains, and hay are the major crops. Forest land occurs mainly on wet bottomland and steep slopes bordering stream valleys. Many of the wetter soils require artificial drainage before field crops can be grown economically. Erosion is a hazard on sloping soils.

Most of the soils are deep, medium, and moderately fine-textured. Moderately well and well-drained soils (Kenyon and Ostrander, Dinsdale, Racine, and Renova series) occur on gently sloping uplands. Somewhat poorly drained (Floyd and Klinger series) and poorly drained (Clyde series) soils occur on nearly level or gently sloping concave positions on uplands. Well-drained and poorly drained soils occur on bottomlands.

The eastern half of the basin is within LRA 105. Feed grains and forage for livestock are the principal crops. Close to one-third of the acreage is in woodland. Erosion on sloping lands and stream overflow on lowlands are the principal land use problems.

Most of the soils are moderately deep and deep, medium textured soils. Well-drained soils, consisting of a loess mantle over bedrock or glacial till, are dominant.

LRA 91 is located in Dakota County in the extreme northern portion of the basin. Approximately 90 percent of the area is in farms; most of it cropland. Feed grains and forage for livestock are the main crops. Soil blowing and conservation of moisture on the sandy soils, water management on wet soils and maintaining fertility are the principal land use problems.

Most of the soils are Psamments. The well-drained and moderately well-drained and the somewhat poorly drained soils are on nearly level sandy outwash plains.

Land Capability

Land capability for agricultural production varies widely in the basin due to a wide range of soil characteristics and landscapes. The USDA land capability classifications show, in a general way, the land resources most suitable for

agriculture. It includes a class and subclass designation. Capability classes are designated by Roman Numerals I through VIII. The numerals indicate progressively greater limitations and narrow choices for cultivated crop production.

Class I soils are productive and suited for intensive cropping. They are not subject to any serious hazards and consequently have no subclass designations. Class II soils have some limitations associated with their use but are productive and suited to cultivated crops when conservation practices are applied. Class III and IV soils have progressively more limitations and require special conservation practices that are more difficult to apply and maintain. Class V soils have limitations, impractical to remove, that limit their use largely to pasture, range, woodland, or wildlife. There are no Class V soils in the basin. Class VI and VII soils have severe limitations that limit their use to pasture, range, woodland, or wildlife. Class VIII soils have very severe limitations that restrict their use to recreation, wildlife, water supply development, or aesthetic purposes.

Four subclasses are used to indicate the type of limitation or hazard associated with the soil resource. Capability subclasses are divisions within a class that are designated by adding a small letter, e, w, s, or c, to the class numeral, for example, IIe. The letter e shows that the main limitation is risk of erosion; w shows that water in or on the soil interferes with plant growth or cultivation; s shows that the soil is limited mainly because it is shallow, droughty, or stony; and c shows that the chief limitation is a climate that is too cold or too dry.

Acres of land by capability class and subclass for the basin's inventoried acreage are given in Table I-2. The inventoried acreage includes all cropland, pastureland, forest land, and other agricultural land. Approximately 80 percent of the soils in the inventoried acreage are Class I through IV and are suited for cultivation when appropriate practices are used to reduce the hazard. Nearly one-half of the basin's land is Class I and II soils and suited to cultivation with the use of relatively few, easily applied, conservation practices.

Erosion hazard is the major limitation of use on two-thirds of the basin's land. Wetness hazard occurs on about 781,900 acres and problems with root zone development occurs on some 394,120 acres. Appendix C, Soils Information, provides greater detail on the basin's land resources and discusses soil associations and soil suitability for various uses.

TABLE I-2 Acreage by Land Capability Class and Subclass 1/

Southeast Minnesota Tributaries Basin, 1975

Capability Class	Subclass "e"	"w"	"s"	"c"	Total
			Acres		
Class I	-	-	-	-	164,450
Class II	1,000,940	471,710	144,540	0	1,617,190
Class III	552,600	211,360	38,450	0	802,410
Class IV	258,360	3,180	40,340	0	301,880
Class VI	137,960	93,540	16,060	0	247,560
Class VII	437,130	0	50,000	0	487,130
Class VIII	0	2,110	2,420	0	4,530
Total	2,386,990	781,900	291,810	0	3,625,150

1/ Consist of only inventoried acreage. Inventoried acreage is the land area remaining after the exclusion of federal lands, urban and built-up land, and water.

WATER RESOURCES

Approximately 97,540 acres of the basin's area is covered by lake basins 1/ ten acres or larger. This is far below the state average of 6.2 percent. Over 40 percent of the lake basins have been affected by drainage. Existing surface water includes approximately 1,700 miles of streams and 293 lakes of ten acres or larger.

Large supplies of ground water exist throughout the basin. The area is underlain by two major aquifers, the Jordan-Prairie Du Chien and the Mt. Simon-Hinckley. These are among the higher yielding aquifers in the United States

1/ A lake basin is a depression in the earth surface that did or does hold water.

and are capable of yielding 500 to 3,000 gpm from wells 400 to 1,800 feet deep. In addition, shallower sand and gravel aquifers, including the St. Peter Sandstone are generally capable of yielding 500 gpm from wells less than 200 feet deep.

Although the water supply is abundant, there are areas within the basin where declining water quality is a major problem. Treatment for hardness and iron content is generally required for the deeper ground water sources. Potential ground water pollution exists from improperly grouted or abandoned wells. Sinkholes in parts of the basin are inlets for pollutants that contaminate ground water.

Fish and Wildlife

Three original vegetation zones occur in the basin; tall grass prairie which include approximately the southwestern third of the basin; the hardwood forest which parallels the Mississippi River in the eastern portion; and the midsection of the basin which is a transition zone between the prairie and the forest.

The great diversity of vegetative cover provides habitat for a variety of wildlife species. Resident or visiting species include woodchuck, striped skunk, muskrat and mink, a host of songbirds and shorebirds, twenty-three species of ducks, three species of geese, various hawks, owls, the bald eagle, and numerous species of mice, voles, and shrews. In addition, thirteen of the fifteen species of snakes and most of the species of turtles identified in Minnesota are found in the basin.

Upland habitat consists of pastureland, hayland, cropland, windbreaks, roadside ditches, and scattered tracts of natural or odd areas. Overall habitat quality is fair, with localized good to excellent areas occurring along the vegetative transition zone and where cropping and grazing are not intensive. Excellent habitat is provided on approximately 38,600 acres of upland which are included within state and federal management areas, generally in association with wetlands.

The dominant woodland game species include the white-tailed deer, ruffed grouse, and squirrels. Winona, Houston, and Fillmore Counties consistantly lead the basin in deer harvest each year. About ten percent of the annual statewide harvest

of deer is currently taken within the SEMT Basin. Major revisions of the deer hunting regulations since the statewide closed season in 1971 have resulted in better management of deer herds and greater options available to hunters regarding seasons and hunt areas.

Beginning in 1926, several unsuccessful attempts were made to reestablish wild turkeys in southeast Minnesota. In 1964, wild birds trapped in other states were released in the Whitewater Refuge and Wildlife Management Area. With an additional release in 1968 and releases between 1971 and 1973 in Houston County, the population has expanded to over 4,000 birds. Transplants from the established flocks are being made to suitable sites in Goodhue, Wabasha, Winona, Olmsted, and Fillmore Counties in an effort to establish the turkey throughout its potential range.

The Mississippi Valley is a major flyway for migrating waterfowl. Major concentrations of waterfowl occur at the Whitewater Refuge and Wildlife Management Area, Upper Mississippi National Wildlife and Fish Refuge, and Silver Lake Park and the State Game Refuge surrounding Rochester, Minnesota. Migrating game species of waterfowl include: Widgeon, mallard, blue-winged teal, green-winged teal, pintail, gadwall, black duck, shoveller, scaup, ringneck, canvasback, and redhead ducks; and Canada, snow, and blue geese. The primary breeding duck is the wood duck which has ideal habitat in the privately owned forested bottoms and tributary outlets. Mallards and blue-winged teal nest in lesser numbers due to a shortage of suitable wetland areas. Rochester's Silver Lake Park and the Refuge surrounding the city provides an overwintering area for over 20,000 giant Canada geese and habitat for a resident flock of about 200.

Wetland and associated nesting and brooding habitat is not abundant. Wetlands, 10 acres or larger, totaling about 16,000 acres are owned or managed by the Minnesota Department of Natural Resources or the U. S. Fish and Wildlife Service. Most of these managed areas occur along the Mississippi River flood plain and major tributaries. Thirty-five state Wildlife Management and National Wildlife Refuge Areas provide 55,220 acres of wetland and upland habitat in the basin.

Some species have not been able to adjust to environmental changes. Species considered threatened or endangered that may be seen in the SEMT Basin include: the golden eagle, the bald eagle, American peregrine falcon, arctic peregrine falcon, and Higgin's Eye pearly mussel (in the Mississippi River).

Fishery resources include streams, inland lakes, reservoirs, and rivers including the Mississippi River pools and Lake Pepin. About 370 miles of streams in the SEMT Basin will sustain trout. There are 270 miles of designated trout streams which support brown and brook trout and some rainbows. These are mostly spring-fed creeks and brooks located in the forested reaches of the major streams and tributaries. The State of Minnesota DNR owns fishing easements along 130 miles of trout streams to provide public access. Management objectives for the trout streams have shifted from annual stocking for put and take fishing, to intensive management of the better streams to establish naturally reproducing, self sustaining populations. Stream designations in the basin are presently under review and will probably result in revisions of the present trout stream designations.

About 79,920 acres of lake basins are classified as fish lakes, marginal lakes, or fish and game lakes (see Table I-3). Most of the inland lakes are man-made, shallow, fertile, and sustain mostly rough fish populations. Largemouth bass, crappies, bluegills, sunfish, and northern pike are found in the better lakes. The majority of the lake fishing areas occur in the Mississippi River Lock and Dam pools and Lake Pepin.

TABLE I-3 Classification of Lake Basins 10 Acres or Larger 1/
(Includes Mississippi River Pools)
Southeast Minnesota Tributaries Basin

Lakes Classifications	Surface Area (Acres)
Lakes With No Information	110
Dry or Drained Lakes	7,490
Game Lakes	10,020
Fish and Game Lakes	43,620
Marginal Fish Lakes	8,220
Fish Lakes	28,080
Total Lake Basins	97,540

1/ MDNR Publication #89 Classifications.

The Mississippi River contains a diverse fishery. The construction of navigation locks and dams has transformed the river into a series of pools from the Twin Cities to the Iowa state line and beyond. These pools and Lake Pepin contain the major commercial fishery of the SEMT Basin. The primary game fish are walleye, sauger, catfish, and some bass. The average annual commercial harvest of carp, buffalo, catfish, and freshwater drum is relatively stable at 10 million pounds. Lake Pepin is highly productive and popular for both sport and commercial fishing.

Recreation Resources

Unique opportunites for outdoor recreation occur within the boundaries of the SEMT Basin. The Mississippi River corridor offers warm water fishing, boating, water skiing, wildlife and waterfowl study, hunting, and unlimited sightseeing opportunities. The rugged topography of the forested portion offers hiking, horseback riding, and cross country skiing opportunities unmatched in Minnesota. Trout streams and canoeing waters are numerous, deer and ruffed grouse hunting are good, and wild turkeys are established and expanding. The western portion offers good pheasant and Hungarian partridge hunting, and some lake and reservoir fishing. Potentials for recreation trail developments are great throughout the basin.

Table I-4 lists the current inventory of public and private recreation facilities in the basin. Except for water based recreation, much of the basin's recreation potential remains untapped. The Cannon, Zumbro, Root, and Straight Rivers are designated canoe streams, with the Vermillion River and others showing potential for future designation. Additional camping, picnicing, and access sites along these streams could greatly expand the facilities needed for these activities.

Current and Projected Resources Use

The distribution of land and water by county is shown in Table I-5. The total drainage area of the basin is 3,898,640 acres. Only 1.7 percent of this area is occupied by lakes, reservoirs or streams. Of the land area, 88 percent is used for cropland, pasture, and forest land production. The remaining 12 percent includes all other land uses.

Table I-4 Summary of Outdoor Recreation Facilities,
Public and Private, 1977
Southeast Minnesota Tributaries Basin

Facility	Unit	Public	Private	Total
Resorts	No.	-	39	39
Resort Family Units	No.	-	236	236
Campgrounds	No.	25	61	86
Walkin + Drivein Campsites	No.	698	2,518	3,216
Camping Area	Ac.	92	197	289
Golf Courses	No.	5	34	39
Golf Holes	No.	72	396	468
Golf Area	Ac.	494	2,544	3,038
Athletic Fields	No.	276	21	297
Tennis Courts	No.	238	14	252
Athletic Activity Area	Ac.	1,577	62	1,639
Picnic Tables	No.	2,518	812	3,330
Picnic Ground Area	Ac.	291	16	307
Water Accesses	No.	58	25	83
Access Parking Spaces	No.	407	377	784
Access Area	Ac.	17	7	24
Rental Boats	No.	4	391	395
Swimming Beaches	No.	13	26	39
Beach Shoreline	Lin.Ft.	4,499	4,910	9,409
Swimming Beach Water	Ac.	7	9	16
Swimming Beach Land	Ac.	12	3	15
Swimming Pools	No.	27	12	39
Pool Surface Area	Sq.Ft.	165,241	40,149	205,390
Recreation Trails (Total Mi.)	1/	244	137	381
Nature Trails	Mi.	35	9	44
Horseback Trails	Mi.	55	60	115
Snowmobile Trails	Mi.	93	49	142
Hiking Trails	Mi.	179	65	244
Bicycle Trails	Mi.	7	15	22
Multi-purpose Trails	Mi.	122	31	153
Fair Grounds	No.	4	2	6
Race Tracks	No.	-	5	5
Highway Rest Areas	No.	53	-	53
Ski Areas	No.	2	3	5
Shooting Ranges	No.	1	16	17
Riding Stables	No.	-	12	12
Public Hunting Areas 2/				
Upland	Ac.	73,834	-	73,834
Wetland	Ac.	16,590	-	16,590

Source: Condensed from computer printout of individual facilities supplied by MDNR Special Program - Strata #203. All facilities are Minnesota portion only.

1/ Multiple use on some trails makes individual use mileages nonadditive to totals.

2/ All areas within state or federal wildlife management areas as listed in Table I-5, plus 35,200 acres included within the state owned Richard J. Dorer Memorial Hardwood State Forest.

Table I-5 Land and Water Distribution

Southeast Minnesota Tributaries Basin, 1975

County	Land Area						Water Area[4]/		
	Urban & Buildup	Federal Land	Cropland	Pasture	Forest	Other[1]/	Large Areas[2]/	Small Areas[3]/	Total Area
	Acres								
Blue Earth	0	0	920	220	105	95	0	5	1,345
Dakota	7,045	425	212,400	21,510	38,195	39,745	9,425	1,625	330,370
Dodge	11,770	0	195,095	14,375	7,570	6,275	0	440	235,525
Fillmore	14,335	0	316,150	54,745	79,555	23,290	185	1,205	489,465
Freeborn	190	0	7,755	250	80	300	0	0	8,575
Goodhue	19,465	5,055	313,920	41,000	72,500	32,030	8,320	1,155	493,445
Houston	9,260	13,905	126,500	30,895	127,800	22,515	3,260	710	334,845
Le Sueur	3,660	0	64,165	5,950	7,750	3,000	5,215	180	89,920
Mower	6,435	0	116,960	5,640	3,005	5,600	0	220	137,860
Olmsted	58,570	0	229,290	52,060	54,700	24,195	640	390	419,845
Rice	18,800	0	197,710	36,810	17,590	18,505	9,360	105	298,880
Scott	75	0	8,920	2,140	1,905	1,240	35	20	14,335
Steele	11,305	0	204,805	6,280	7,180	14,235	1,150	235	245,190
Wabasha	6,305	3,270	187,165	43,805	72,000	19,035	8,960	1,860	342,400
Waseca	2,600	0	38,525	4,230	1,410	2,820	2,220	165	51,970
Winona	14,045	2,315	194,200	45,000	118,595	22,800	5,760	1,775	404,490
Allamakee Iowa	0	0	160	0	20	0	0	0	180
Total	183,860	24,970	2,414,640	364,910	609,960	235,680	54,530	10,090	3,898,640

1/ Rural land which is not otherwise classified. It includes such areas as farmsteads, feedlots, fence rows, rural nonfarm residence and marshes not used for grazing.
2/ Includes lakes or reservoirs greater than 40 acres in size and streams greater than 1/8 mile wide.
3/ Includes lake or reservoirs less than 40 acres in size and streams less than 1/8 mile wide. Acres expanded from 1967 CNI. Because of computation method, these figures may not agree with figures elsewhere in this report.
4/ Does not include Mississippi River pools.

U S DEPARTMENT OF AGRICULTURE

SCALE 5 0 5 10 15 20 MILES

Scale 1/500,000

LEGEND

- BASIN BOUNDARY
- STATE BOUNDARY
- COUNTY BOUNDARY
- STATE CAPITAL
- COUNTY SEAT
- TOWN OVER 10,000
- TOWN 1,000-10,000
- PRIVATE LAND OWNERSHIP
- PRIVATE FORESTED LAND
- STATE LAND OWNERSHIP
- STATE FORESTED LAND
- FEDERAL LAND OWNERSHIP
- FEDERAL FORESTED LAND

LAND OWNERSHIP
AND FOREST LAND
SOUTHEAST MINNESOTA TRIBUTARIES BASIN

portion of the

SOUTHERN MINNESOTA RIVERS BASIN STUDY

MINNESOTA, SOUTH DAKOTA, AND IOWA

4·26·74
5,S-34,086 8

CREDIT:
MAP DATA FROM MINNESOTA STATE PLANNING AGENCY.
MINNESOTA LAND MANAGEMENT INFORMATION CENTER. FOREST COVER BASED ON 1969 INVENTORY. LAND OWNERSHIP COMPILED IN 1973.

SOURCE
1/250,000 USGS QUADRANGLES, LATE EDITION
COUNTY HIGHWAY MAPS AND 1974 STATE HIGHWAY MAP. TRANSVERSE MERCATOR PROJECTION

The growth of population, industry, and associated services has resulted in conversion of agricultural and forest land to other land uses. Projections of land needed to accommodate housing, transportation, business, and industrial growth have been made using a 1974 update of the SCS Conservation Needs Inventory (CNI) land use classification. Increases are projected in urban and built-up land and other inventory land. Decreases are projected in cropland, pasture and forest land.

Forestry Resource

The basin contains 609,960 acres of forest land which is about 16 percent of the land area (See Land Ownership and Forest Land Map). Commercial forest land accounts for 540,000 acres. More than 90 percent of the forest area is privately owned, although the Minnesota Department of Natural Resources (DNR) is actively purchasing acreage in the Richard J. Dorer Memorial Hardwood State Forest. Most forest lands are found on steep slopes, in flood plains, and other areas not conducive to tillage. Approximately 89 percent of the forested acres in the region are commercial.

The Richard J. Dorer Memorial Hardwood State Forest is an area of rolling wooded hills and streams that covers all of Wabasha, Winona, and Houston Counties, and portions of Dakota, Goodhue, Olmstead, Dodge, and Fillmore Counties. Approximately 38,200 acres have been acquired by the state. If acquisition continues as planned, 83,000 acres will be acquired by the year 1990. These lands have been identified by the State DNR as having great potential for multiple uses such as community forestry, recreation, and wildlife management. Much of the income produced by the DNR from these lands is returned directly or indirectly to local units of government.

Three major forest types exist within the basin; oak, bottom land hardwood, and northern hardwood. The oak type is the predominant forest type in the basin. Its major components are red, white and bur oak and it occurs on nearly three-fourths of the forest land. It is found on the steep slopes and poorer soils.

The bottom land hardwood type is found on ten percent of the forest land. It occurs mostly along streams, on poorly drained soils, and on the Mississippi River flood plain. The major species found in this type are American elm, silver maple, and cottonwood.

The northern hardwood type accounts for seven percent of the forest area and occurs primarily on north and east facing slopes and other areas of moist but well drained soils. The main species making up this type are basswood, red oak, American elm, hickory, and sugar maple.

Black walnut is an associated species in the above three types. Though it accounts for less than one percent of the sawtimber volume, it is important because of its high value.

Approximately 60 percent of the stands are less than 70 percent stocked with desirable trees. The percentage breakdown of the forest land by stand size classes is as follows: sawtimber, 41 percent; poletimber, 34 percent; seedling and sapling, 13 percent; and nonstocked, 12 percent.

In 1975 the harvest of forest products in the basin totaled 4.1 million cubic feet. This included 15.3 million board feet of sawlogs and 1.7 million board feet of veneer logs. Over 95 percent of the veneer logs and 11 percent of the saw logs were exported from the basin for processing. Table I-6 shows projections of growth and harvest with the ongoing program. Forest product needs in the basin can be met through 2020.

Table I-6 Commercial Forest Area
Net Annual Growth and Roundwood Production
Southeast Minnesota Tributaries Basin

Year	Commercial Forest (Acres)	Net Annual Growth (Million Cu. Ft.)	Roundwood Production (Million Cu. Ft.)
1975	539,566	14.03	4.11 1/
1985	538,083	15.07	10.12 2/
2000	535,983	16.61	14.21 2/
2020	534,293	18.70	18.29 2/

1/ Actual production. Source "Minnesota Mill Study, 1975".
2/ OBERS Projections, 1972. Series E.

The increasing emphasis on wood as an energy source will have an effect on the forest resource. Intensive forest

Severely eroding land that should be revegetated to trees.
(Photo Courtesy of Minnesota DNR)

Much of the forest land is located on steep valley slopes.
(Photo Courtesy of Minnesota DNR)

management will become more economically feasible with a strong market for the poorer quality and smaller sized material Conversely, some indiscriminate cutting of stands will occur. However, the net result should be beneficial to the forest resources.

Agricultural Production

The combination of soil, topography and climate in the basin provides a favorable environment for the production of a variety of crops. Corn is the major crop and is grown throughout the basin. In 1977 Minnesota ranked fifth among states in corn and soybean production and the Southeast Minnesota Tributaries Basin produced about ten percent of the state's soybeans and 12 percent of the state's oats. Other row crops produced are primarily sweet corn, green peas and other vegetable crops.

Forage crops, which are grown primarily to support the basin's livestock enterprise, utilize about forty percent of the land area. Approximately 548,000 acres of cropland are used for silage, hay and pasture. Alfalfa is the second most prevalent crop grown in the basin. In addition, there are about 635,000 acres of permanent pasture and grazed forest land in the basin.

Other crops grown include wheat, rye, barley, and specialty crops primarily consisting of apple orchards. It is estimated that only one percent of the cropland is idle.

Current and projected crop production for the basin is given in Table I-7. These projections represent the supply capability of the basin assuming the without plan conditions. The without plan conditions reflects the effects of major land use shifts, ongoing land treatments and moderate yield increases from improved management and adoption of new technologies. The value of all crops is expected to increase 17 percent by 1985, 34 percent by 2000 and almost 50 percent by 2020. These projections assume yields will not be reduced as a result of erosion or other unforeseen circumstances.

The most significant increase is the production of soybeans which is expected to nearly double by 2020. During the same time, corn production is projected to increase twenty percent in the basin. The production of hay is similarly projected to increase 35 percent. Increased pasture production from

Table I-7 Projected Agricultural Production
Future Without Development Conditions 1/
Southeast Minnesota Tributaries Basin

Land Use	Production (Units)	Current Land Use (Acres)	Current Production (See Units)	Current Value ($)	1985 Land Use (Acres)	1985 Production (See Units)	1985 Value ($)	2000 Land Use (Acres)	2000 Production (See Units)	2000 Value ($)	2020 Land Use (Acres)	2020 Production (See Units)	2020 Value ($)
				(000)									
Cropland		2,414.6	---	357,321	2,411.7	---	421,684	2,398.5	---	483,935	2,319.2	---	538,523
Corn	bu.	834.3	80,072	198,578	699.4	87,812	217,775	666.5	102,867	255,110	685.2	119,462	296,266
Silage	T.	130.0	1,689	27,875	108.8	1,640	27,060	88.4	1,635	26,984	93.8	1,915	31,598
Soybeans	bu.	351.5	8,543	43,484	532.2	13,966	71,087	605.0	16,397	83,461	571.9	17,865	90,933
Oats	bu.	231.7	12,696	17,774	283.0	18,348	25,687	283.2	20,706	28,980	297.1	24,253	33,954
Alfalfa	T.	373.5	1,291	55,493	385.5	1,529	65,744	402.3	1,759	75,637	356.1	1,657	71,251
Other Hay	T.	44.4	123	3,683	51.7	165	4,950	40.8	145	4,350	41.1	159	4,770
Pasture	AUD	286.7	29,811	10,434	248.8	26,803	9,381	213.6	26,894	9,413	174.4	27,860	9,751
Other row crops		50.7	---	7,992	56.9	---	8,731	56.0	---	9,688	57.8	---	11,252
Other small crops		82.7	---	9,724	16.8	---	2,219	14.6	---	2,235	13.8	---	2,349
Specialty		5.7	---	1,404	4.9	---	1,404	4.6	---	1,343	4.6	---	1,535
Idle		23.4	---	0	23.4	---	0	23.5	---	0	23.5	---	0
Pasture	AUD	364.9	33,068	11,574	349.5	34,894	12,213	326.5	36,221	12,677	312.0	38,416	13,466
Grazed Forest	AUD	269.7	10,749	3,762	249.2	10,024	3,508	218.8	8,864	3,102	178.2	7,412	2,594
Commercial Forest	Thousand Cu.Ft.		4.11	764 2/		10.12	6886 2/		14.21	2,649 2/		18.29	3,409 2/

1/ These projections were developed as a part of this study utilizing a mathematical model designed to assess the basin's agricultural potential.

2/ Stumpage value (does not include harvesting and transportation).

*Grazed forest and commercial forest do not agree with total forest land in Table I-5 because of the overlaping use.

improved management and ongoing land treatments is expected to be almost equally offset by decreased pasture acreage and reduction of grazed forest land. Very little change in total pasture production in the basin is projected for the without plan condition.

The projected supply capability reflected in Table I-7 was compared to the OBERS E' allocated share of agricultural production. 1/ The OBERS, series E' projections are a nationally consistent set of projections developed for the National Water Resources Council for water resource planning purposes. Although significant increases in production are projected for the basin, they fall short of the Series E' allocated share of national production. The corn and soybean production is short by about 11 percent in 1985 and 18 percent in 2000 and 2020.

Livestock enterprises in the basin compliment the crop production activities. About thirty percent of the value of all crop production comes from forage crops which are necessary to support the basin's livestock. Nearly 1.5 million acres or 38 percent of the basin's land area is currently used for growing silage, hay, and all pasture including grazed forest.

Livestock activities in the basin include dairying, beef cattle, hogs, and poultry. There have been few significant changes in the quantity of livestock raised in the basin over the last twenty years. The number of milk cows has generally declined as have the number of sheep and broilers. The number of beef cattle, hogs, and turkeys fluctuate with cyclic conditions, but show no significant long term trends.

Projections of livestock products, livestock numbers, and roughage feed requirements were made for the basin. The projections were developed from the OBERS E' state and water resource area projections. Estimated 1974 and projected 1985, 2000, and 2020 livestock products for the basin are shown in Table I-8. These demand projections reflect increased national needs for milk, meat, and poultry products.

1/ Greater detail of assumptions and development of these projections is available in 1972 OBERS Projections of Economic Activities, Series E' by the Water Resources Council, Washington, D.C. and in unpublished reports and data files of the Economics, Statistics, and Cooperatives Service, USDA, East Lansing, Michigan.

Feed conversion rates and ration composition for the various livestock categories were used to project roughage requirements. These requirements were compared to the basin's supply capabilities. The projected silage, hay and pasture production in Table I-7 represents the projected supply capability of the basin without resource development. These projected levels of roughage production fall short of that necessary to produce the basin's allocated share of livestock products. The shortage is about 14 percent in 1985 and 2000 and twenty percent in 2020.

Table I-8 Livestock Production, 1974-2020

Southeast Minnesota Tributaries Basin

	Units	1974	1985	2000	2020
Beef & veal	lbs	280,165	366,099	396,571	393,909
Pork	lbs.	225,031	228,562	247,581	256,891
Lamb & mutton	lbs	4,433	2,140	1,926	3,061
Chickens	lbs	4,144	3,235	2,088	1,199
Broilers	lbs	1,400	2,022	2,618	3,154
Turkeys	lbs	36,410	49,995	67,694	81,469
Eggs	doz	23,353	16,012	9,886	4,525
Milk	lbs	2,372,378	2,519,327	2,693,122	3,170,001

Source: 1972 OBERS Projections, Series E' National Water Resources Council, Washington, D.C.

CHAPTER II
PROBLEMS AND CONCERNS

INTRODUCTION

This chapter outlines the major problems and concerns related to the basin's water and related land resources. Identification and investigation of problems and concerns were done in two phases. Phase I consisted of identifying problems and concerns and inventorying the resources. To accomplish this, the Southern Minnesota Rivers Basin Board distributed questionnaires to local citizens, the policy committee, technical field personnel, and various state agencies for their inputs. The USDA investigated these concerns to quantify the magnitude of each problem. Phase II activities, discussed in later chapters, consisted of formulating alternative solutions and making recommendations to solve the problems identified.

During Phase I nine concerns were identified as needing detailed investigation. These concerns and their order of importance are listed below:

1. Erosion and Sedimentation
2. Water Pollution
3. Conflicting Land Uses
4. Poor Condition of the Forest Resource
5. Wet Agricultural Soils
6. Flooding
7. Loss of Fish and Wildlife Habitat
8. Inadequate Recreation Opportunities
9. Inadequate Water Supply

Erosion and Sedimentation

A major resource problem concerning land use and management in the basin is erosion and resulting sedimentation. This process of detachment and transportation of soil materials by erosion forces is accelerated by agricultural or other activities which disturb protective surface cover. These processes not only reduce the productivity of soils, but also impair the quality of water resources.

The greatest erosion problem in the basin is sheet and rill erosion on cropland. This occurs mainly on cultivated and erosive soils that lack proper treatment and management. A major portion of the basin consists of areas with steep and erosive slopes which is conducive to accelerated erosion problems.

Of the 2.4 million acres of cropland in the basin, 1.7 million acres have erosion as the major hazard limiting its use. These erosive soils, constituting nearly 72 percent of all cropland in the basin, are subject to moderate to very severe erosion unless they are protected. At present 696,280 acres, or 29 percent of the cropland, have an annual soil loss in excess of the long-term tolerance level. (The long term tolerance level assigned to each soil by SCS is the maximum gross erosion which could exist without reducing productivity.)

Erosion problems on pasture have resulted in some parts of the basin from overgrazing. However, because of the number of acres involved, these problems are not as significant as those on cropland.

Accelerated erosion from grazed forest land is also a problem. Some 270,000 acres, or 44 percent of the forest, are grazed. The animals harm the site by causing severe soil compaction and by disturbing the soil's protective litter cover. As a result, infiltration and percolation rates decrease, runoff and erosion volumes increase, nutrients are lost, and site productivity declines. It is estimated that over 1.2 million tons of soil is lost each year from grazed forest land.

Table II-1 shows the current sheet and rill erosion rates on cropland, pastureland and forest land.

Sediment deposition resulting from sheet and rill erosion.

Over 13 million tons of soil are lost each year from cropland.

Table II-1 Current Sheet and Rill Erosion Rates

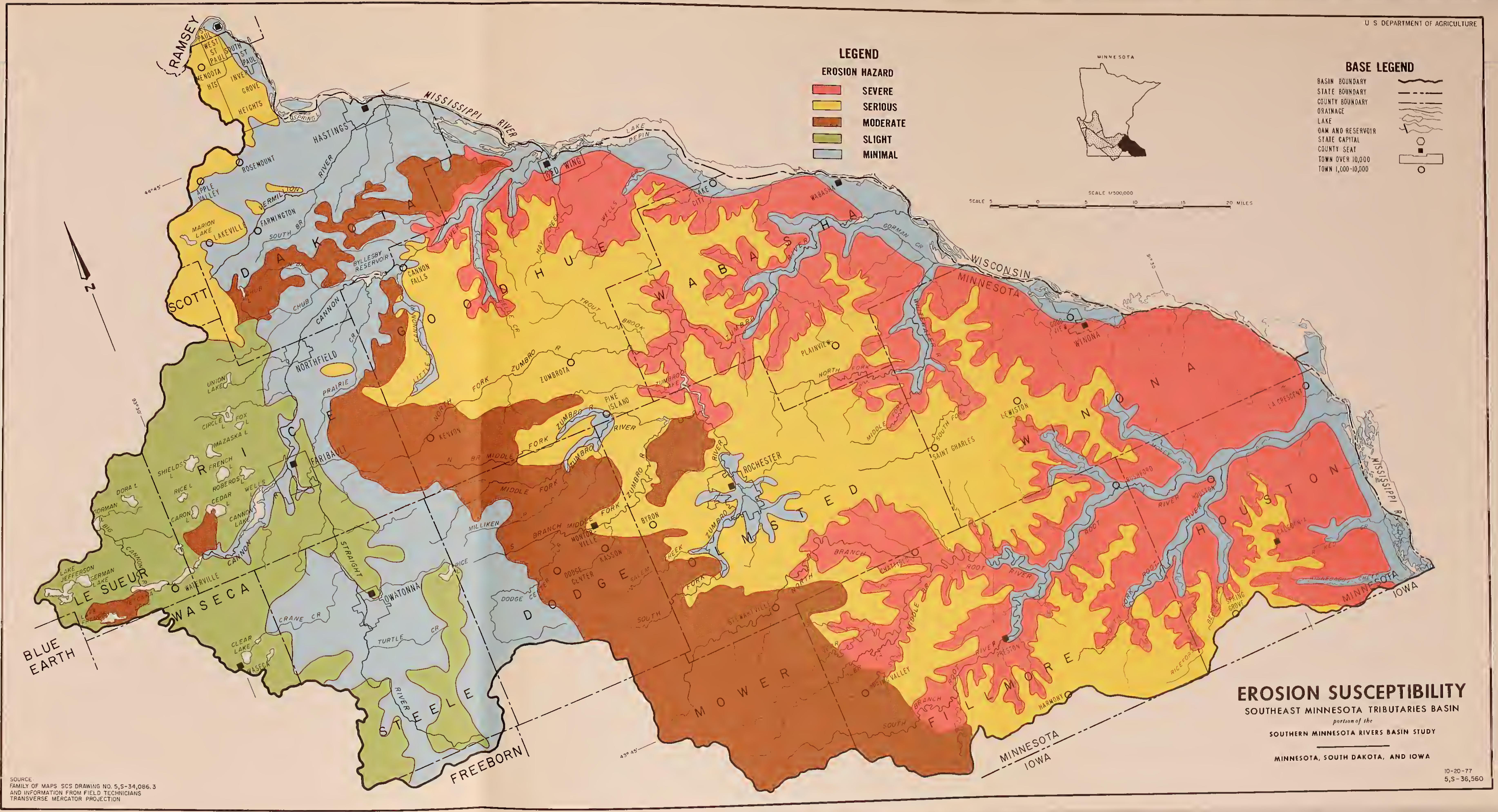
Southeast Minnesota Tributaries Basin

Source	Acres	Annual Soil Loss (1000 tons)	Rate (Ton/Ac/Yr)
Cropland			
Exceed Tolerance	696,280	10,426	15.0
Less than Tolerance	1,718,360	3,129	1.8
Pastureland	364,910	1,496	4.1
Forest Land			
Ungrazed	340,230	76	0.2
Grazed	269,730	1,250	4.6
Total 1/	3,389,510	16,377	4.8

1/ Includes only cropland, pastureland and forestland. No estimates were made for urban and other lands.

The Erosion Susceptibility Map on the following page identifies areas with varying degrees of erosion hazard. The map designation for erosion hazards imply that, in general, similar conditions exist because of soil type, slope, rainfall, and runoff. It should be recognized that within each erosion hazard category all conditions undoubtedly occur to some degree and further investigations are warranted on a site specific basis. This map was prepared for the SEMT report and may not totally agree with other maps published previously.

Other concerns in the basin are associated with gully and streambank erosion. Gully erosion is caused by flowing water and results in the formation of channels that cannot be smoothed out by normal cultivation. These gullies range in depth from 2 feet to 100 feet and are a hazard to the farm operator, his equipment, and livestock. The gullying process is accelerated by lack of vegetative cover and is generally most severe in cultivated areas on rolling topography. This condition exists in the southeast portion of the basin, however, many of the gullies have become inactive. Studies of upland gully erosion in forest areas show that undisturbed forest land normally has few gullies. However, there are localized erosion problems which have occurred as a result



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of overgrazing, poor management, or intensive land use on or above steeply sloping forest land. The Upland Gullying Map indicates areas having high gully formation potential and the present estimated number of gullies per square mile.

Streambank erosion is the removal of soil from the banks of rivers and streams. This soil removal occurs principally during flood flows. Approximately 600 miles of streams and rivers in the basin are affected by streambank erosion. Streambank erosion causes damage to bridges, roads, highways and wildlife habitat. It also adds to the problem of water quality. The Streambank Erosion Map locates areas along stream reaches that are affected by varying degrees of erosion.

Table II-2 shows the future erosion condition for cropland, pastureland, and forest land. The Universal Soil Loss Equation (USLE) was used to estimate sheet and rill erosion for cropland under projected cropping patterns and land treatment conditions. The projected land treatments for cropland include increased use of contouring, stripcropping, and terraces. It also assumes some critical areas, currently used for row crops, will be placed in permanent cover crops. The future without plan assumes additional use of reduced and conservation tillage practices in farm operations. The percentage of crop acreage in conservation tillage is estimated to increase from 22 percent in 1975 to 43 percent in 2000. This increase will occur primarily on lighter soils in the basin. The land treatment for the grazed forest land not adequately protected is primarily the reduction or elimination of grazing.

Sediment is a problem that is a result of erosion. The major source of sediment is erosion from cropland. Pastureland and forest land are also sediment sources but to a lesser degree. Over 16 million tons of soil are displaced each year from the basin's cropland, pastureland and forest land. The amount that enters streams and lakes is over one million tons annually. Evidence of this is observed through the reduced capacity of lakes and streams, eutrophication of lakes, and reduced water quality.

Sediment from high-velocity streams is deposited on flood plain areas and in the stream channels. Such sediment also reduces the effectiveness of drainage ditches and the productivity of agricultural land. Rivers flood more frequently each year as stream channels become choked with sediment. Sediment deposited on the floodplain not only destroys crops, but also makes the land less suitable for crop production.

Table II-2 Erosion, Future Without Plan Condition

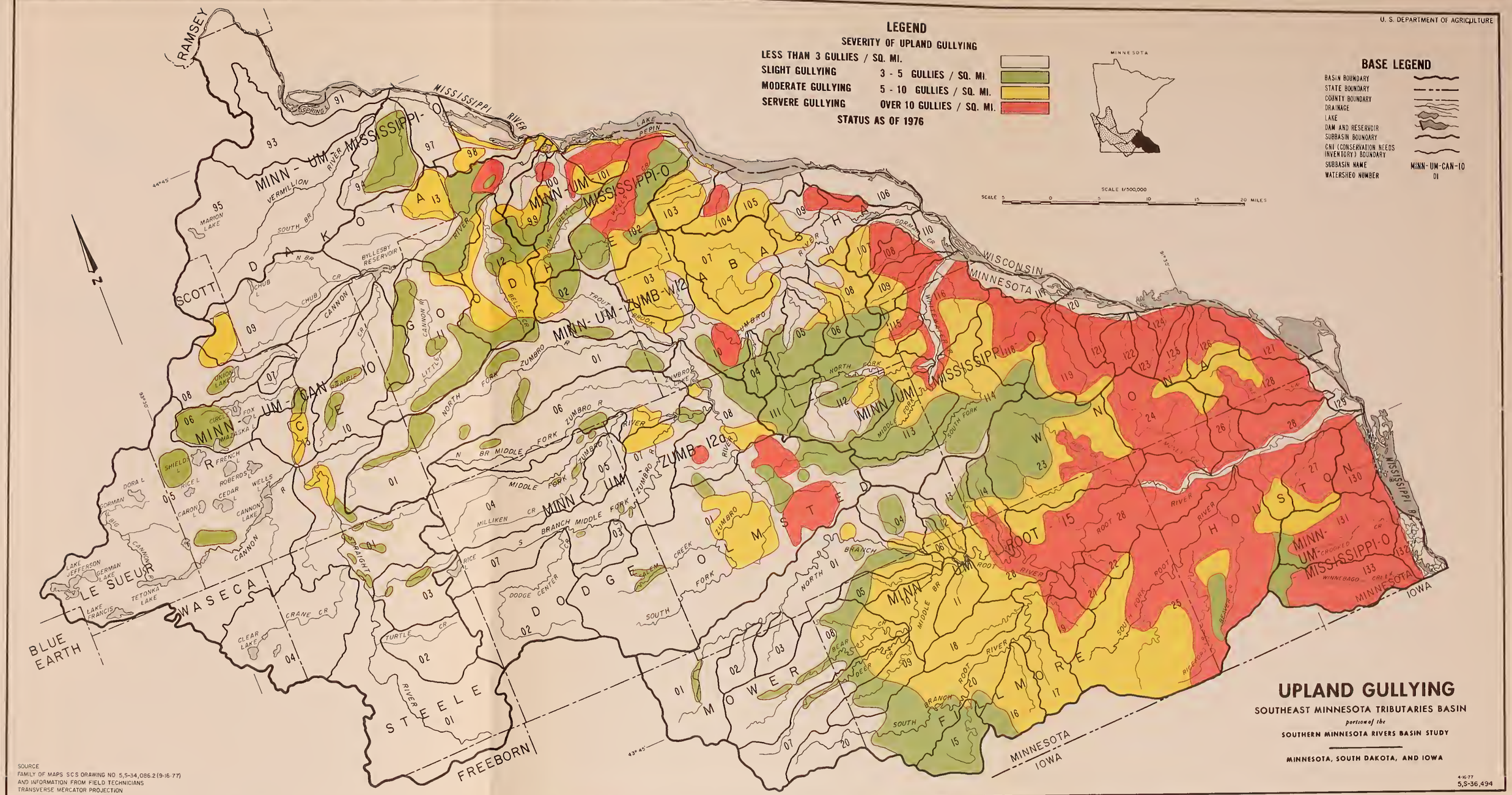
Southeast Minnesota Tributaries Basin, 1985-2000

Source and Year	Acres	Annual Soil Loss (1000 tons)	Rate (Ton/Ac/Yr)
1985			
Cropland			
Conditions Exceeding Tolerance	606,430	8,829	14.6
Conditions Within Tolerance	1,805,310	3,243	1.8
Pastureland	349,510	1,398	4.0
Forest Land			
Ungrazed	358,760	123	0.3
Grazed	249,180	1,143	4.6
Total	3,369,190	14,736	4.4
2000			
Cropland			
Conditions Exceeding Tolerance	502,050	7,147	14.2
Conditions Within Tolerance	1,896,430	3,322	1.8
Pastureland	326,540	1,273	3.9
Forest Land			
Ungrazed	386,350	149	0.4
Grazed	218,780	982	4.5
Total	3,330,150	12,873	3.9

WATER POLLUTION

Surface Water Pollution

Lakes in the basin have high levels of phosphorus, nitrogen, and moderately high levels of alkalinity. A major source of nutrients to these lakes is overland runoff from farmlands.


U. S. DEPARTMENT OF AGRICULTURE
LEGEND
SEVERITY OF UPLAND GULLYING
LESS THAN 3 GULLIES / SQ. MI.
SLIGHT GULLYING 3 - 5 GULLIES / SQ. MI.
MODERATE GULLYING 5 - 10 GULLIES / SQ. MI.
SERVERE GULLYING OVER 10 GULLIES / SQ. MI.
STATUS AS OF 1976
MINNESOTA
SCALE 1/500,000
SCALE 5 0 5 10 15 20 MILES
BASE LEGEND
BASIN BOUNDARY
STATE BOUNDARY
COUNTY BOUNDARY
DRAINAGE
LAKE
DAM AND RESERVOIR
SUBBASIN BOUNDARY
CNI (CONSERVATION NEEDS INVENTORY) BOUNDARY
SUBBASIN NAME MINN-UM-CAN-10
WATERSHED NUMBER 01
RAMSEY
WASHINGTON
DAKOTA
SCOTT
CARVER
LE SUEUR
WASECA
BLUE EARTH
FREEBORN
STEELE
DODGE
OLMSTED
GOODHUE
WABASHA
WINONA
HOUSTON
MOWER
FILLMORE
WISCONSIN
MINNESOTA
IOWA
MISSISSIPPI RIVER
LAKE PEPIN
MINN-UM-MISSISSIPPI-01
MINN-UM-MISSISSIPPI-02
MINN-UM-ZUMB-W2
MINN-UM-ZUMB-120
MINN-UM-CAN-10
MINN-UM-MISSISSIPPI-CROOKED CR
UPLAND GULLYING
SOUTHEAST MINNESOTA TRIBUTARIES BASIN
portion of the
SOUTHERN MINNESOTA RIVERS BASIN STUDY
MINNESOTA, SOUTH DAKOTA, AND IOWA
4-16-77
5,S-36,494
SOURCE
FAMILY OF MAPS SCS DRAWING NO 5,S-34,086.2 (9-16-77)
AND INFORMATION FROM FIELD TECHNICIANS
TRANSVERSE MERCATOR PROJECTION
USDA-SCS-LINCOLN, NEBR 1978


U. S. DEPARTMENT OF AGRICULTURE
MINNESOTA
BASE LEGEND
BASIN BOUNDARY
STATE BOUNDARY
COUNTY BOUNDARY
DRAINAGE
LAKE
DAM AND RESERVOIR
SUBBASIN BOUNDARY
CNI (CONSERVATION NEEDS INVENTORY) BOUNDARY
SUBBASIN NAME MINN-UM-ROOT-15
WATERSHED NAME 22
SCALE 1:500,000
SCALE 5 0 5 10 15 20 MILES
LEGEND
STREAMBANK EROSION PROBLEM AREAS
N
RAMSEY
WISSISSIPPI RIVER
LAKE PEPIN
WISCONSIN
MINNESOTA
SCOTT
DAKOTA
GOODHUE
WABASHA
WINONA
HOUSTON
MINN-UM-MISSISSIPPI-01
MINN-UM-MISSISSIPPI-02
MINN-UM-MISSISSIPPI-03
MINN-UM-CANNON-10
MINN-UM-ZUMB-WI-12
ZUMB-12
MINN-UM-MISSISSIPPI-04
MINN-UM-MISSISSIPPI-05
ROOT-05
MINN-UM-MISSISSIPPI-06
MINN-UM-MISSISSIPPI-07
MINN-UM-MISSISSIPPI-08
BLUE EARTH
LE SUEUR
WASECA
STEELE
DODGE
OLMSTED
FREEBORN
MOWER
FILLMORE
IOWA
MINNESOTA
SOURCE:
FAMILY OF MAPS SCS DRAWING NO.5,S-34,086-2
AND INFORMATION FROM FIELD TECHNICIANS
TRANSVERSE MERCATOR PROJECTION
STREAMBANK EROSION
SOUTHEAST MINNESOTA TRIBUTARIES BASIN
portion of the
SOUTHERN MINNESOTA RIVERS BASIN STUDY
MINNESOTA, SOUTH DAKOTA, AND IOWA
11-8-77
5,S-36,449
USDA-SCS-LINCOLN, NEBR. 1978

Serious erosion problem developing in roadside ditch.

Gully formations on steeply sloping land.
(Photo Courtesy of Minnesota DNR)

In many instances, surface runoff from agricultural fields carries with it large amounts of sediment, nutrients, and pesticides which eventually find their way into streams, lakes, and sinkholes.

A significant sources of water pollution, aside from the sediment and associated non-point sources discussed in the previous section, is feedlot runoff.

It has been estimated that as many as 11,000 of the basin's 14,000 farms include feedlots, which range in size from a few animals to more than a thousand head. It is further estimated that as many as 1,600 of these feedlots are located within shoreland (i.e., within 300 feet of a stream or 1,000 feet of a lake), where the potential for discharge to surface water is highest. These feedlots in close proximity to surface waters, in particular, are significant potential pollution hazards.

Field surveys were conducted in about 600 of these feedlots within shoreland as part of the State Water Quality Management Planning Program. The data analysis resulting from these surveys focused on several indicators of pollution. It showed that over 95 percent of the feedlots analyzed within shoreland discharge runoff in the design (25-year/24 hour rainfall) storm. Nearly all of the feedlots analyzed which had a discharge in the design storm had BOD levels in excess of the point sources standard (25 ppm).

Pollution from feedlots occurs when water crossing a feedlot washes off or dissolves pollutants from the manure and runs off, carrying those pollutants into ground or surface waters. Since there is a high incidence of discharge or feedlot runoff, at least within shoreland, there is concern about the potential impacts of the variety of pollutants carried in the runoff.

Pathogenic organisms present on and around the animals and in their excretions can cause disease in humans as well as other animals. Phosphorous and nitrogen compounds present in the runoff may cause a variety of problems. Phosphorous and sometimes nitrogen, can accelerate the eutrophication of lakes. These materials can damage rivers. Ammonia, a form of nitrogen, is toxic to some fish. Nitrate, another form of nitrogen, may cause disease in humans and some animals. BOD causes depletion of oxygen in receiving waters. This depletion can cause fish kills and odors.

In its 1977 Report to Congress on Minnesota Water Quality, the Minnesota Pollution Control Agency (MPCA) cites significant numbers of violations of fecal coliform and pH standards

along the stretch of the Mississippi River bordering the SEMT Basin. The Cannon and Root Rivers were cited as having relatively high levels of fecal coliforms attributed to agricultural runoff and municipal point sources.

All streams monitored by the MPCA in the basin have similar types of water quality problems: quite frequent violations of the instream standards for fecal coliforms, turbidity, and high levels of phosphorus, nitrates, ammonia and suspended solids. In assessing this water quality data, however, it must be emphasized that the sampling stations of the primary monitoring network are generally placed in known or suspected problem areas - usually below major point source dischargers. As a result, data indicating poor water quality at the monitoring stations may not always be indicative of water quality throughout the basin.

Ground Water Pollution

While the potential for surface water pollution is a significant concern, ground water can also be polluted. The Karst area within the basin is very susceptible to ground water pollution.

The Minnesota Geological Survey has found that "almost any surface activity.....which produces effluent is likely to contaminate the underlying Karst aquifer." 1/ This means that all feedlots and other sources of pollution in the Karst terrain of the basin must be considered as threats to water quality unless appropriate management practices have been installed or detailed investigation of the site shows that no hazard exists. If feedlot runoff enters the ground water bacteria may be filtered out; but pathogenic viruses may remain. The viruses and the water's nitrate content are of concern when the water is used for consumption.

Ground water contamination is not limited to the limestone formations. Degradation in ground water quality is also extending to water in the deeper and normally protected aquifers. This is demonstrated by increasing levels of nitrate in some of these deeper formations. The city of

1/ Sigma Associates, Inc., 1979.

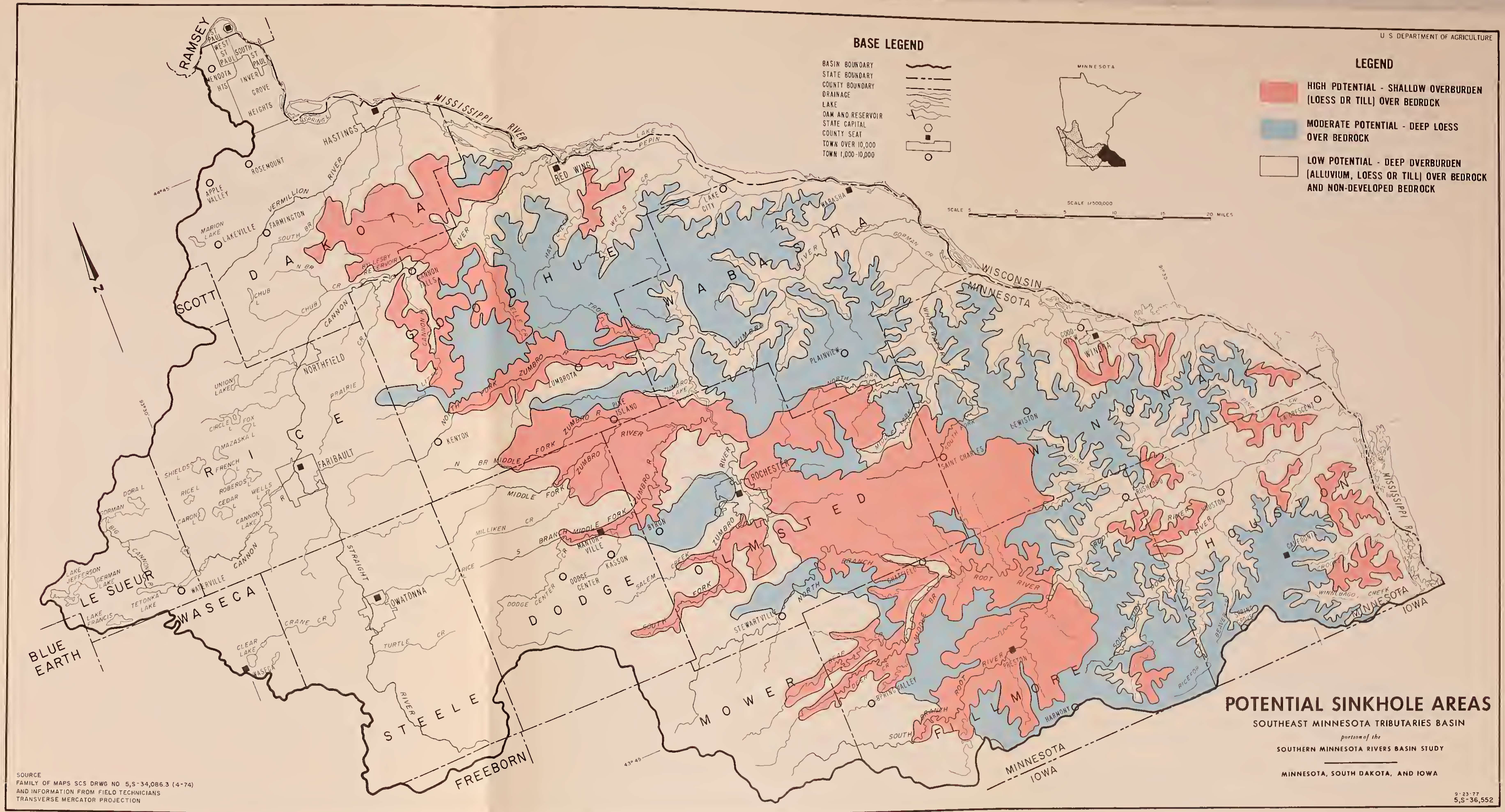
Caledonia constructed new wells in 1954 and 1960, and properly grouted into the Jordon sandstone formation, to replace wells that drew water from both of the Shakopee-Oneota dolomite and Jordan sandstone formations. With time the nitrate nitrogen level in the new wells has increased and some of the samples have exceeded the maximum 10 mg/l level established by the National Primary Drinking Water Regulations. Similar problems have occurred at other locations in southeastern Minnesota. Grouted public and private wells developed exclusively in the Jordon sandstone in some areas of Houston, Wabasha, and Winona Counties are beginning to show elevated concentrations of nitrate. 1/

Surveys have indicated that water in a majority of private wells in the area is contaminated. No comprehensive data are available to specifically define the trend in contamination of ground water in southeastern Minnesota, although available information suggests that there will be increasing contamination of both deep and shallow aquifers. Future water quality is difficult to predict and the rate of improvement will probably vary in different areas. Those areas where point sources are relatively more important than non-point sources (below larger municipalities) will show more rapid changes with point source treatment improvements.

Conflicting Land Uses

Land use conflicts were expressed as a significant concern by the people in the basin. The urban-rural conflict is confined primarily to the area around Rochester in Olmsted County and the area around the Twin Cities including Dakota, Scott, Goodhue, and Rice Counties. The problem is caused by scattered uncontrolled residential, commercial, and industrial developments in agricultural and unique areas. Problems that result from unplanned development are; loss of prime agricultural land, conflicts between development and preservation of natural areas, adverse environmental effects resulting from development of unsuitable land, and high cost of providing services for unguided urban growth.

1/ Report to the Legislative Committee on Minnesota Resources from the Minnesota Department of Health, Problems Relating to Safe Water Supply in Southeastern Minnesota, December 1976.



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With the growth of population, industries, and associated services, more pressure is placed on agricultural and forest land to shift to higher valued uses. Projections of land needed to accommodate additional housing, tranportation, business, and industrial growth were made. According to the SCS Conservation Needs Inventory (CNI) land converted to accommodate these uses will be cropland, pastureland, and forest land.

Table II-3 illustrates the current land use and projected land use changes in the basin. These projections assume no further water resource projects beyond those currently authorized. The changes in water area are those expected to occur from private development as well as currently authorized projects. Increases in urban land acreage is related to the population projections. Cropland, pasture and forest acreages in Table II-3 represent the net effect of shifts to urban uses as well as shifts from pastureland and forest land to cropland.

Table II-3 Current Land Use and Projected Changes In Major Land Use

Southeast Minnesota Tributaries Basin

Land Use	1975 (Acres)	Projected Change 1985 (Acres)	2000 (Acres)	2020 (Acres)
Cropland	2,414,640	- 2,900	-16,160	-23,450
Pastureland	364,910	-15,400	-38,360	-52,950
Forest Land	609,960	- 2,010	- 4,830	- 7,260
Other Land	235,690	+ 6,590	+15,080	+21,160
Urban & Built-Up	183,850	+13,370	+42,520	+60,750
Fed. Non-Cropland	24,970	0	0	0
Water	64,620	+ 350	+ 1,750	+ 1,750
Total	3,898,640			

Poor Condition of the Forest Resource

Approximately 60 percent of the forest land is less than 70 percent stocked with desirable trees. The potential to

Feedlots are a source of surface water pollution.

Sinkholes are a common occurrence in the Karst topography area.

provide water, forest products, outdoor recreation and wildlife is not being adequately realized. In its present condition the forest provides only minimal watershed protection and timber growth is approximately forty percent of its potential. The quality of recreational opportunities and of the wildlife habitat is far below what they could be.

Some of the reasons for the poor condition of the forest resource are small ownerships, lack of concern by forest owners to manage and improve their forest lands, poor markets for small sized and lower grade materials and a shortage of vendors to do the needed forest management work.

Table II-4 shows the present and projected conservation treatment needs for the forest land with on going programs. These practices are designed to reduce or control erosion and improve the productivity of the forest resources.

The Land Ownership Map, located in Chapter I, shows the location of the forest land in the basin.

Table II-4 Conservation Treatment Needs - Forest Land

Southeast Minnesota Tributaries Basin

Treatment Needs	Units	1975	1985	2000	2020
Reduce or eliminate grazing	Ac.	195,900	178,950	150,720	113,080
	Percent	32	29	25	19
Reforestation 1/	Ac.	93,980	86,380	75,070	60,220
	Percent	16	14	12	10
Timber Stand 1/ Improvement	Ac.	282,460	277,800	270,910	262,360
	Percent	46	46	45	44
Total	Ac.	572,340	543,130	496,700	435,660

1/ Includes grazed forest land.

Wet Agricultural Soils

Wet agricultural soils were a concern identified in the basin. Investigations show that wet agricultural soil problems are related to soil types and the lack of adequate outlets. Areas having these problems are scattered throughout the basin. The most prominent areas are located in the western half of the basin (See Wet Agricultural Soils Map).

Poorly drained or wet soils are a problem because they interfere with land preparation, tillage, plant development, and harvest operations. This contributes to reduced crop yields, increased production costs, lower quality products, and more energy use.

There are approximately 538,750 acres of cropland in the basin which are classified as "w" soils. The "w" indicates that water in or on the soil surface interferes with the growth of agricultural crops and tillage operations. Of this 538,750 acres, 394,120 acres are adversely affected by wetness.

It has been projected that the going program will provide for drainage of an additional 126,500 acres of cropland. Therefore, the selected plan provides no additional emphasis on drainage of wet agricultural lands.

Flooding

Flooding, while not of major concern throughout the basin, is a significant problem in areas where it occurs. The Root and Zumbro Rivers have the largest flood prone area of the subbasins (See Table II-5). Historical data indicates that flooding became a problem in many of the areas after uplands were deforested and planted to row crops.

In the remaining tributaries, the Vermillion, Cannon, and Whitewater, the areas subject to annual floods are primarily in pasture, forest, or wildlife land use and are thus subject to lower cash losses. As shown on the Major Flood Damage Areas Map and the Land Ownership and Forest Land Map, the major flooded areas are primarily in forest land.

Table II-5 shows agricultural damages and does not reflect flooding damages in urban areas. Urban flood damage can be extensive. This was demonstrated by the devastating floods in Rochester in 1978. Many of the smaller communities throughout the basin experience various degrees of flooding.

July 1978 flooding in Rochester, Minnesota.

Urban flooding in Rochester, Minnesota.

Table II-5 Area Flooded and Annual Dollar Damage

Southeast Minnesota Tributaries Basin - 1977

Location	Max.* Area Flooded (Acres)	Avg. Annual Agri. Damage (Dollars)
Root River	27,070	$ 1,103,710
S. F. Zumbro River	10,580	431,530
Remaining Zumbro River	31,440	1,282,160
Whitewater River	6,100	248,960
Direct Tributaries to the Mississippi River	7,800	317,960
Vermillion River	2,850	116,180
Straight River	5,090	207,490
Belle Creek	2,440	99,580
Cannon River	4,070	165,930
Total	97,440	$ 3,973,500

* 100-Year Flood Plain

Studies by the Corps of Engineers in many of these communities have indicated that there are very few feasible structural solutions.

Major floods on the larger rivers occur on the average of one or two years out of ten. Spring floods are the predominant problem. Flood records show the greatest freqency of occurrence in April during snow melt on frozen ground. Rainstorms can be expected as early as mid-March. Spring rainfall, combined with melting snow, result in frequent spring floods.

Many of the quiet, gentle mill streams and valley farms of the early 1800's have been abandoned to swamped and wooded wildlife land. Because of erosion of top soils, sedimentation, and frequent floods, much land is no longer economical to farm. The abandoned valleys flood more often than once a year.

Reduction of flooding in the future will occur with the installation of the South Zumbro and the Belle Creek Water-

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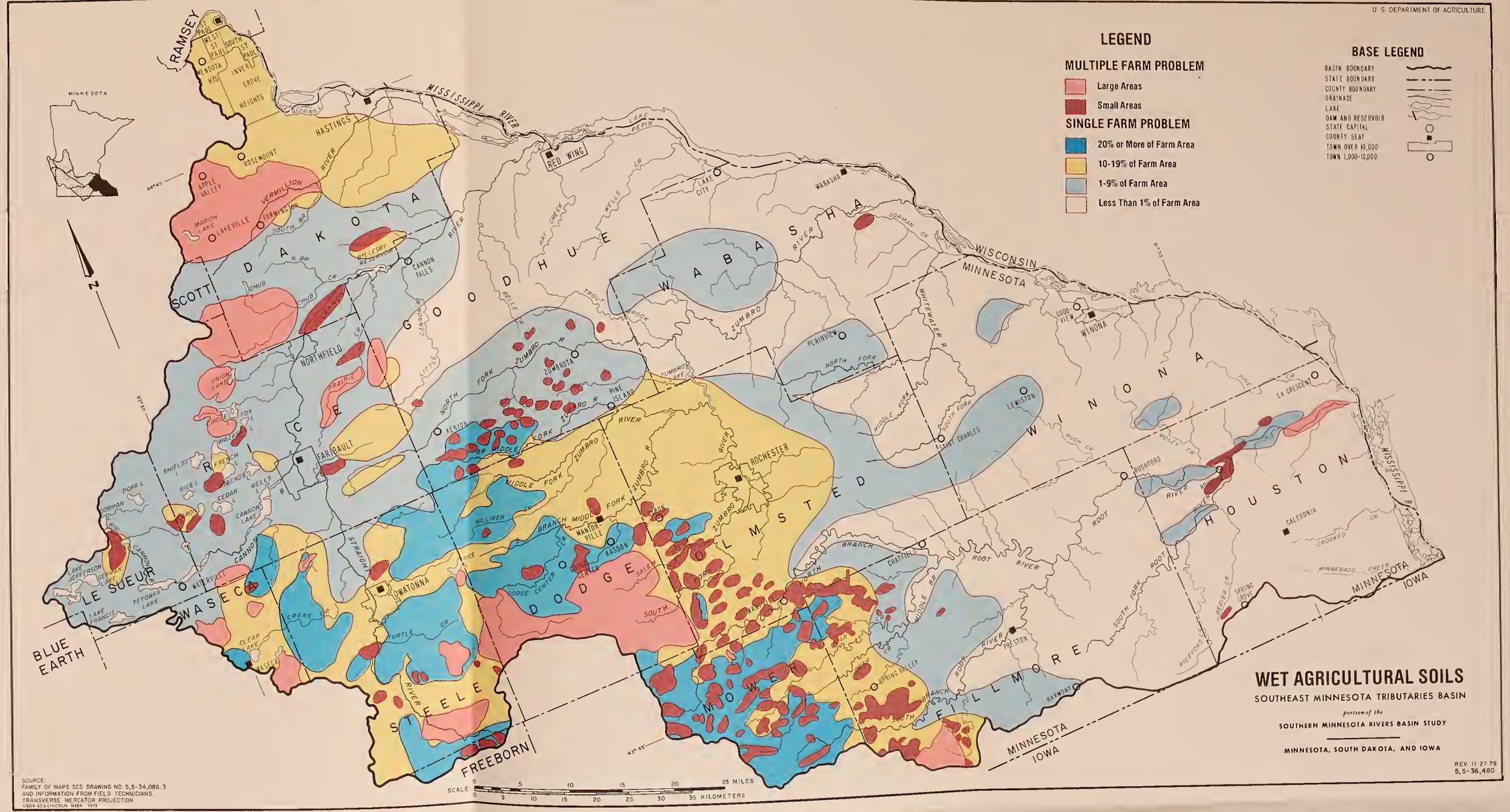

WET AGRICULTURAL SOILS

SOUTHEAST MINNESOTA TRIBUTARIES BASIN

portion of the

SOUTHERN MINNESOTA RIVERS BASIN STUDY

MINNESOTA, SOUTH DAKOTA, AND IOWA

REV 11-27-79
5,S-36,480

SOURCE:
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AND INFORMATION FROM FIELD TECHNICIANS.
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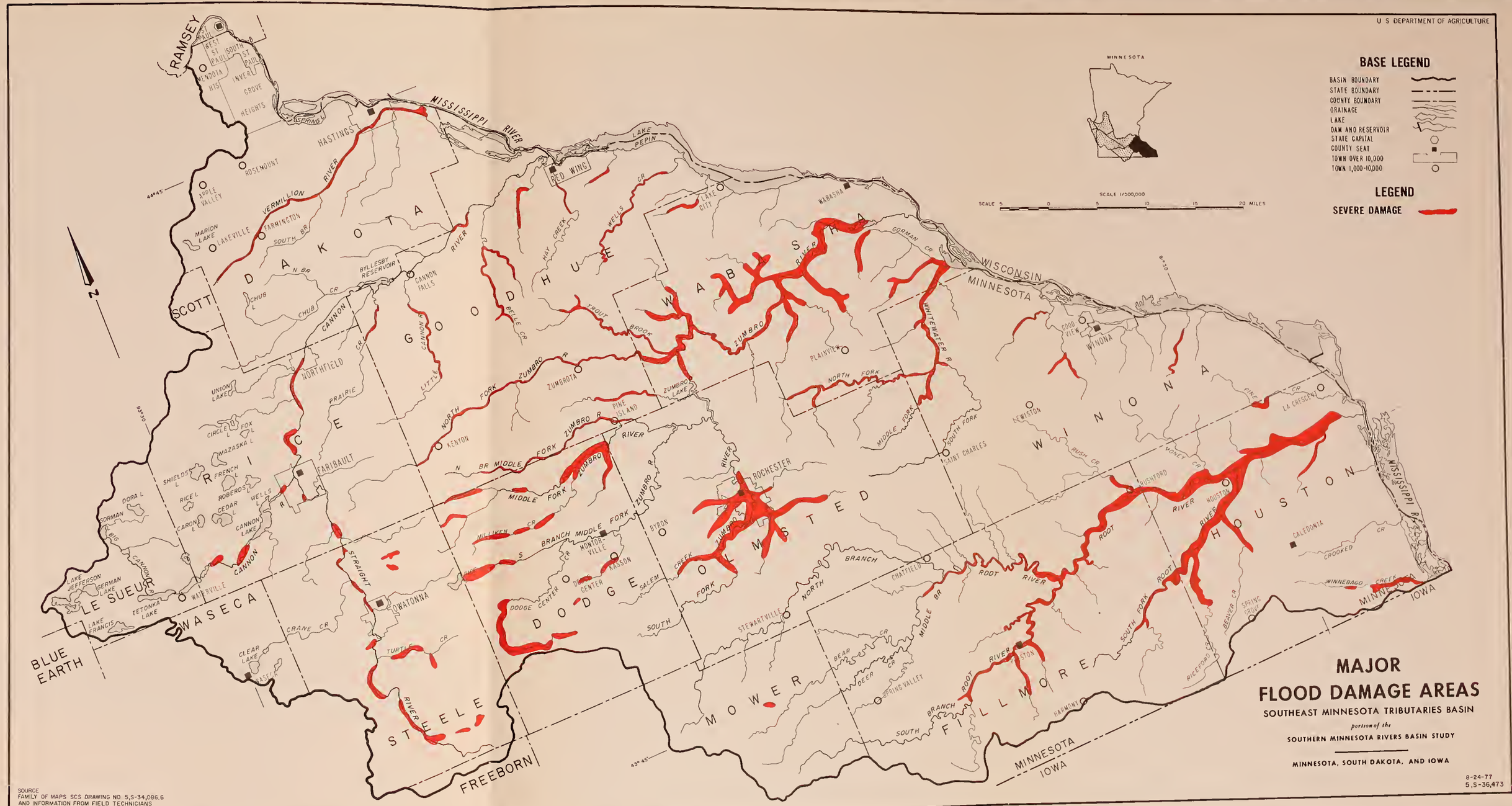
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MINNESOTA
BASE LEGEND
BASIN BOUNDARY
STATE BOUNDARY
COUNTY BOUNDARY
DRAINAGE
LAKE
DAM AND RESERVOIR
STATE CAPITAL
COUNTY SEAT
TOWN OVER 10,000
TOWN 1,000-10,000
LEGEND
SEVERE DAMAGE
SCALE 1:500,000
SCALE 5 0 5 10 15 20 MILES
N
RAMSEY
WASHINGTON
DAKOTA
SCOTT
GOODHUE
WABASHA
WINONA
HOUSTON
LE SUEUR
WASECA
BLUE EARTH
FREEBORN
STEELE
DODGE
OLMSTED
MOWER
FILLMORE
WISCONSIN
MINNESOTA
IOWA
MISSISSIPPI RIVER
LAKE PEPIN
RED WING
HASTINGS
ROSEMOUNT
APPLE VALLEY
LAKEVILLE
FARMINGTON
CANNON FALLS
NORTHFIELD
FARIBAULT
WATERVILLE
OWATONNA
CLEAR LAKE
DODGE CENTER
ROCHESTER
KASSON
MONTEVIDEO
STEWARTVILLE
CHATFIELD
PLAINVIEW
ZUMBROTA
KENYON
LAKE CITY
WABASHA
GOOD VIEW
WINONA
ALTURA
MINNESOTA CITY
SAINT CHARLES
RUSHFORD
HOUSTON
CALEDONIA
LA CRESCENT
SPRING GROVE
RICEFORD
HARMONY
CANNON RIVER
ZUMBRO RIVER
ROOT RIVER
WHITEWATER R
MIDDLE FORK ZUMBRO R
NORTH FORK ZUMBRO R
SOUTH FORK ROOT RIVER
MIDDLE BR ROOT RIVER
NORTH BRANCH ROOT RIVER
SOUTH BRANCH ROOT RIVER
VERMILLION RIVER
CRANE CR
TURTLE CR
BEAR CR
DEER CR
BEAVER CR
WINNEBAGO CREEK
CROOKED CREEK
SPRING VALLEY
MAJOR
FLOOD DAMAGE AREAS
SOUTHEAST MINNESOTA TRIBUTARIES BASIN
portion of the
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MINNESOTA, SOUTH DAKOTA, AND IOWA
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SOURCE
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AND INFORMATION FROM FIELD TECHNICIANS
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shed projects. The South Zumbro Watershed has a completed plan and environmental impact statement and the Belle Creek Watershed project is being constructed. These two projects, planned under PL-566, will reduce average annual acres flooded by 2,700 acres in the South Zumbro and 890 acres in the Belle Creek Watershed. The 100 year flood will continue to affect approximately 93,850 acres of rural land. Remaining average annual dollar damage will be 3,032,900 dollars.

During the detailed investigation of this study, several small watersheds were investigated as to their feasibility under PL-566, the Small Watershed Protection Program sponsored by the Soil Conservation Service. None of the structural alternatives considered resulted in economic feasibility, therefore, no recommendations are included in this report for flood control action (See Table II-6). Recommendations are included by the Southern Minnesota River Basin Board, however, for alternative means of reducing flood damages.

Table II-6 Watersheds Investigated for Flood Damage Reduction

Southeast Minnesota Tributaries Basin

Watersheds	Drainage Area(Ac)	Measure1/ Analyzed	Avg.Ann. Cost$	Avg.Ann. Benefit$	Benefit Cost Ratio
Cedar Valley	11,481	2 FRS	23,500	19,670	.8:1
Harkcom Creek	11,800	1 FRS	19,410	14,630	.8:1
Spring Creek	16,688	2 FRS	84,880	21,090	.3:1
Thompson Valley	24,500	2 FRS	33,250	18,160	.6:1

1/ Floodwater retarding structures.

Loss of Fish and Wildlife Habitat

The major problems for wildlife within the basin are continued loss of habitat to other land uses and deteriorating quality of remaining habitat. These problems result from increased demands on land and water resources, primarily for agricultural production and urban expansion.

The major losses of woodland habitat are to country home sites, expanded crop production, and recreation developments. Overgrazing, burning, and improper management have reduced the quality of woodland habitat. Inadequate ground cover, improper distribution, and stand maturity are resulting problems.

Wetland habitat in the basin is primarily restricted to the Mississippi River flood plain and near the mouths of the Cannon, Whitewater, Zumbro, and Root Rivers. Wetlands in the agricultural western portion of the basin have shown a continual decline. Where viable wetlands remain intact, surrounding nesting habitat is generally lacking due to overgrazing, burning, or encroachment by croplands. Eutrophication and sedimentation have accelerated the evolution of many wetlands to a more shallow, drier type of habitat.

Future fish and wildlife habitat quality and quantity are primarily dependent on uses made of the land and water resources. Projected land use shifts from pastureland and forest land to cropland, and a net increase in urban uses will further reduce the quantity of wildlife habitat in the basin. Some improvement in habitat quality will result from the installation of land treatment practices under the going programs, as well as practices installed to reduce nonpoint source pollution under the Rural Clean Water Program. No specific wildlife habitat improvement measures have been proposed in this study but is inherent in the land treatment program proposed for the reduction of erosion and sediment.

Inadequate Recreation Opportunities

Recreation was rated as a lesser concern within the basin, however, lake based recreation opportunities are extremely limited and deficient. Of the 97,540 total acres of lake basins in the basin, 54 percent are contained within the Minnesota portions of the Mississippi River Lock and Dam pools and Lake Pepin. Major problems exist due to the polluted condition of several reaches of the Mississippi River. Also, high user concentrations occur due to the limited availability of the surface water resources. Problems with depth, sediment, eutrophication, and water quality restrict the use of many inland lakes for fishing and other recreation purposes (See Table II-7).

Tree planting in the Richard J. Dorer Memorial Hardwood Forest
(Photo Courtesy of Minnesota DNR)

The Richard J. Dorer Memorial Hardwood Forest has great potential for recreational development.

Table II-7 Identified Lake Problems and Needs 1/

Southeast Minnesota Tributaries Basin

County	Name of Lake	Problems														Needs					
		Siltation	Weed	Algae	Water Level Fluctuation	Shore Erosion	Swimmer's Itch	Rough Fish	Fish Winter Kill	Salinity	Pollution					More Surface Area	More Depth	Wildlife Habitat	Public Access	More Recreation Facilities	Surface Use Regulations
											Industrial	Agricultural	Municipal	Private							
Dakota	Byllesby	x		x				x			x	x	x			x		x	x		
	Chub	x		x			x					x		x							
	Spring	x		x							x	x	x	x							
Dodge	Rice	x		x				x	x			x				x	x				
	Marion	x			x	x								x							
Goodhue	Pepin	x						x			x		x				x	x	x		
Houston	South Fork (R-3)		x	x			x	x					x				x	x	x	x	
	Shamrock (R-2)		x					x				x					x	x	x	x	
	Lawrence	x	x					x								x					
	Target	x	x					x					x	x		x					
LeSuer	Tetonka	x		x								x		x							
	Sabre								x			x		x							
Mower	East Side	x		x			x					x		x							
	Pine Lawn Park	x																			
Olmsted	Zumbro	x	x	x	x	x	x	x		x	x	x	x	x	x	x	x	x	x	x	x
	Shady	x			x	x		x				x	x	x			x	x	x	x	
	Florence	x						x	x			x		x			x	x		x	
	Mayowood	x	x									x	x				x		x	x	
	Silver	x				x		x			x	x	x				x	x			
Rice	Roberts			x								x		x							
	Rice	x		x														x			
	Mud	x		x														x			
Steele	Oak Glen		x															x	x		
	Beaver													x					x		x
Waseca	Loon		x	x									x	x							
	Clear		x	x			x		x				x	x							
Winona	No Lakes																				
Totals	26	18	9	13	3	4	5	11	4	1	5	14	11	14	1	9	11	9	8	4	
Rank		1	5	3	9	8	7	4	8	10	7	2	4	2	10	5	4	5	6	8	

1/ Problems were identified by summarizing phase I questionnaires.

Facilities for camping, picnicking, swimming, fishing, and trail activities are deficient basin wide. These deficiencies are further aggravated by demand pressures from the Twin Cities metropolitan area. The more popular lakes are overcrowded and will continue to be until demands are redistributed to areas not presently accessible or which are now underutilized. The rate of land acquisition for the Richard J. Dorer Memorial Hardwood State Forest has decreased, and thus the development of its planned recreation facilities.

Other recreation problems include shortage of equipment, fencing, and funds for trout stream improvement, and a lack of trails designated for use by trail bikes and other all terrain vehicles. Because of the steep topography and fragile soils, trails for trail bikes and all terrain vehicles should be restricted to suitable areas and then be carefully constructed and maintained.

Resources are not available to supply the projected demand for boating, water-skiing, sailing, and lake fishing when considered as independently occurring activities on separate acres on a peak day. Even the addition of the Wisconsin portions of the Mississippi River pools and Lake Pepin (91,665 acres) results in a deficiency of 172,000 acres of recreation water by the year 2000. Thus, water based activities are extremely resource limited. Access to all lakes and reservoirs with potential to supply these activities will probably be provided in the future. Time and space zoning will probably be instituted to reduce congestion and provide proper segregation of incompatible uses. These measures, as well as lake improvements and new reservoir construction, will not however, supply the resources needed. The remaining demand will have to be shifted to resources outside of the SEMT basin.

Inadequate Water Supply

Concern expressed in the Southeast Minnesota Tributaries Basin over water supply is primarily a problem of water quality. According to the Minnesota State Planning Agency, known sand and gravel aquifers are capable of meeting present and future foreseeable needs. However, it is of vital importance that the quality of ground water resources be protected if these needs are to be met. The problems associated with water quality were addressed in the Water Pollution Section.

CHAPTER III
SELECTED PLAN

Introduction

On April 6, 1978, the SMRB Board had a public meeting in Rochester, Minnesota to present alternative plans to the local people, policy committee, and the various state agencies in attendance. The USDA presented six alternative plans plus the future without plan conditions. These six plans focused on the need for carrying out a sound soil and water conservation program within the basin. The variable among the six alternatives presented was the degree of emphasis placed on sediment and erosion problems, forest management, pasture use and management, and drainage of cropland. At this meeting, it was requested that the USDA prepare a packet of material that summarized these plans and mail it to participants for their review and comments.

The USDA, in consultation with the SMRB Board, discussed the results of the information received from the public. Plan effects and costs were also discussed with the board. Plan D was selected as the plan that would be most acceptable for solving the identified problems in the basin. Heavy emphasis is placed on controlling the erosion and sedimentation problems. Elements of the six alternative plans are discussed in Chapter V. Elements of the selected plan are discussed in the following paragraphs.

Selected Plan Elements (Plan D)

Erosion and sedimentation was identified as the top priority problem within the basin. Since many of the other identified concerns are directly related to the wise use and conservation of the land resource, it was decided that the implementation of resource management systems be the foundation upon which other actions are based.

Resource management systems are combinations of conservation practices and management measures used to maintain or improve soil, water, plant, and animal resources. These are shown as selected plan elements in Table III-1. Under present state and federal laws resource management systems are voluntarily installed by landowners and operators.

The primary objective for a resource management system is to provide essential treatment to maintain sustained use of the resource base. In addition, conservation plans are developed with objectives which strive to improve the quality of the environment and improve the standard of living.

The systems are planned to include all land treatment measures that are essential to the protection and planned improvement for the desired use and within the capability of a particular land area. Technical assistance for planning and installation of land treatment measures is available from the SCS and Forest Service, in cooperation with the Division of Forestry, Minnesota Department of Natural Resources, through the soil and water conservation districts.

Some of the specific conservation practices recommended to be applied include:

Conservation Practice	Description of Practice
Cropland	
Conservation Cropping System	Growing crops in combination with needed cultural and management measures to reduce erosion and improve or maintain physical condition.
Crop Residue Management	Using plant residues to protect cultivated fields during critical erosion periods to conserve moisture, increase infiltration, reduce soil loss, and improve soil tilth.
Grassed Waterway or Outlet	A natural or constructed waterway or outlet shaped or graded and established in vegetation suitable to safely dispose of runoff from a field, diversion, terrace, or other structure.

Table III-1 Selected Plan Elements and Comparison of Future Without Plan - Year 2000
Southeast Minnesota Tributaries Basin

Plan Elements	Future Without Plan	Selected Plan (Plan D)	Future With Plan D
Conservation Land Treatment	- Acres Protected -		
A. Cropland			
1. Contouring	16,150	23,280	39,430
2. Stripcropping	92,480	94,630	187,110
3. Terrace 1/	41,480	38,790	80,270
4. Permanent Cover	7,100	27,790	34,890
5. Other Treatment 2/	105,490	78,000	183,490
TOTAL	262,700	262,490	525,190
B. Pasture Management			
(establishment, reestablishment, brush control and protection)	2,160	2,840	5,000
C. Forest Land Management			
1. Woodland Grazing Control	45,200	68,400	113,600
2. Tree Planting	18,900	37,500	56,400
3. Timber Stand Improvement	11,500	0	11,500
Total	75,600	105,900	181,500

1/ Acres protected with terrace.
2/ Includes reduced tillage, residue use, and other conservation cropping systems.

Conservation Practice	Description of Practice
Conservation Tillage System	A form of noninversion tillage that retains protective amounts of residue mulch on the surface throughout the year.
Contour Farming	Farming sloping cultivated land in such a way that plowing, preparing land, planting and cultivating are done on the contour to reduce erosion and provide water control.
Stripcropping	Growing crops in a systematic arrangement of strips or bands across the general slope (not on the contour) to reduce water erosion. The crops are arranged so that a strip of grass or a close-growing crop is alternated with a clean-tilled crop or fallow.
Terraces	An earth embankment or ridge and channel constructed across the slope at a suitable spacing to reduce erosion damage.
Minimum Tillage	Limiting the number of tillage operations to those that are properly timed and essential to produce a crop and prevent soil damage.
Cover and Green Manure	A crop of close-growing grasses, legumes, or small grain grown primarily for seasonal protection and soil improvement.
Pastureland	
Pasture and Hayland Planting	Establishing and reestablishing long-term stands of adapted species of forage plants.
Brush Management	Managing and manipulating stands of shrubs and short, scrubby trees on pastureland by mechanical, chemical, or biological means or by prescribed burning.

Conservation Practice	Description of Practice
Pasture and Hayland Management	Proper treatment and use of pasture-land or hayland.
Forest Land	
Tree Planting and Seeding	Tree planting, replanting, reinforcement planting, direct seeding, reseeding, or reinforcement seeding for timber production, watershed protection, or other purposes.
Timber Stand Improvement	Thinning, weeding, release, pruning or other stand improvement practices so as to maintain maximum stand vigor.
Proper Harvesting Practices	Prescribed harvesting which includes proper felling, limbing, bucking, skidding, yarding, loading, transportation and all activities involved in processing the tree from stump to the mill yard. Includes proper bedding of cat roads, skid roads, and other harvest areas.
Grazing Control	Acres eliminated from or protected from destructive grazing through fencing or changes in land use.
Other Land	
Agricultural Waste Management System	A planned system to contain and manage liquid or solid wastes, including runoff from concentrated waste areas with ultimate disposal in a manner which does not degrade air, soil, or water resources.
Agricultural Waste Storage Facility	A fabricated structure for temporary storage of animal or other agricultural wastes.
Farmstead and Feedlot Windbreak	A belt of trees or shrubs next to a farmstead or feedlot to protect soil resources, control snow

Conservation practices will reduce erosion and protect the soil.

Conservation tillage reduces erosion and cuts production cost.

Conservation Practice	Description of Practice
Farmstead and Feedlot Windbreak (Cont'd.)	deposition, provide human comfort, prevent wind damage, provide shelter for livestock and to beautify or improve an area for wildlife.
Wildlife Upland Habitat Management	Retaining, creating, or managing wildlife habitat on the upland.
Streambank Protection	Stabilizing and protecting banks of streams and lakes against scour and erosion by vegetative or structural means.

Emphasis in this plan is placed on treating areas identified as having critical erosion problems. It is recommended that land treatment be applied on 52 percent of the soils in land capability Class IIe, 37 percent of the soils in Class IIIe and IVe, and 11 percent of the soils in Class VIe and VIIe. By the year 2000, it is anticipated that 70 percent of the erosive cropland and 61 percent of all cropland in the basin will be adequately protected. Plan D also recommends that land treatment be applied on 2,840 acres of pastureland and 105,900 acres of forest land. Recommendations for forest land treatment include the application of woodland grazing control on 68,400 acres of grazed forest land. Tree planting is recommended for 37,500 acres.

In the sinkhole areas, educational programs and technical assistance are needed to prevent sinkholes from being used for disposal sites, and outlets for feedlot drainage. Also, further development in these areas should be discouraged. Further studies are needed to determine the effects that various treatment practices will have on water movement in these areas.

The elements included in the selected plan represent the first step in addressing the identified water and related land resource problems in the Southeast Minnesota Tributaries Basin. Concurrent with carrying out the selected plan, other opportunities for solving the identified problems should be explored and undertaken. Programs of various federal, state, and local agencies are identified in Chapter IV which should also be considered.

Effects of the Selected Plan

Application of conservation land treatment on cropland, pastureland, forest land and other land will reduce the wind and water erosion, and resulting sedimentation within and downstream from each watershed within the basin. This will result in more efficient use of land and water resources. A comparison of the effects on erosion and sedimentation by implementation of the selected plan with the future without plan is shown in Table III-2.

Table III-2 Comparison of the Effects of the Selected Plan With the Future Without Plan - Year 2000 Southeast Minnesota Tributaries Basin

Problems and Concerns	Units	Present	Remaining Problem - 2000 Without Plan	Remaining Problem - 2000 With Plan
I Erosion	Million Tons/Yr.			
A. Cropland	"	13.6	10.5	8.5
B. Pastureland	"	1.4	1.3	1.2
C. Forest Land	"	1.3	1.1	0.7
II. Sediment Delivered to Lakes & Streams	"	1.0	0.8	0.7

As land is adequately treated to control erosion; the amount of sediment and associated pollutants, including nitrogen, phosphorus, and potassium will be reduced. If sediment is reduced by 10 percent the phosphorus associated with this sediment reduction may be decreased by 60 to 80 percent and nitrogen by 20 to 50 percent. 1/ Under these circumstances,

1/ Harms, Leland, L. et al. "Physical and Chemical Quality of Agricultural Land Runoff," Journal Water Pollution Control Federation, 46, 11, 2460, November, 1974.

the total phosphorus load of streams could be reduced by six to eight percent. In like manner nitrogen would be reduced by two to five percent. By maintaing more of these materials on the land, soil fertility and productivity are increased which provides economic benefits to the landowner. Installation of agricultural waste management systems will reduce agricultural runoff constituents, which will in turn reduce concentrations of suspended solids, nutrients, organic materials, and fecal coliforms in streams.

It is estimated that with complete implementation of this plan, total erosion (cropland, pastureland, and forest land) will be reduced by twenty percent. The installation of the planned land treatment will reduce sediment delivered to lakes and streams by 164,000 tons per year.

As land treatment is applied on upland areas, it will not only reduce soil erosion but will improve open land habitat. Permanent cover applied to 27,790 acres of critical area and improved management on 234,700 acres of cropland, 2,840 acres of pastureland and 105,900 acres of forest land will provide more food and cover for wildlife during critical winter periods.

Forest management, tree planting, and grazing control will reduce erosion by about 400,000 tons per year by the year 2000. The volume of timber will be increased while providing mixed age stand conditions for deer and grouse.

Land treatment practices which improve the hydrologic condition of the soil will tend to reduce flood runoff and maintain low flows. Storm runoff potential is a correlation between many factors including rainfall amount and duration, soil type, and vegetative cover. Practices which develop good soil tilth and desirable water infiltration rates are most effective in providing reduced runoff rates.

Soil surveys are available to assess land capabilities for general land use planning and policy controls. They can be useful in assessing hazards and development problems, in comparing different areas for a specific use, and in planning more detailed investigations at selected sites. Land use changes in this plan include the conversion of 27,790 acres of Class VI and VII cropland to permanent cover.

Improvement of wildlife habitat will occur through the application of the land treatment plan. It is anticipated that hunting opportunities will also be improved on 371,230 acres of land as a result of implementation of the selected plan.

Accounts Display

In keeping with the Principles and Standards for Water and Related Land Resources Planning a system of accounts display has been developed to display the beneficial and adverse effects of the selected plan. This includes a display of the distribution of national economic development, environmental quality, regional development, and social well-being effects to regions. The application of these procedures is commensurate with the level of planning, benefits realized, and environmental characteristics of the area and within the scope and significance of the study. The system of accounts display is included in the following pages.

Selected Plan
National Economic Development Account
Southeast Minnesota Tributaries Basin

Components Beneficial Effects:	Measure of Effects (Average Annual $) 1/	Components Adverse Effects:	Measure of Effects (Average Annual $) 2/
The value to users of increased outputs of goods and services.		The value of resources required for a plan.	
Added return from agricultural production from land treatment systems.		Land Treatment Cost 3/	
Cropland	1,349,000	Cropland	1,265,000
Pastureland	239,000	Pastureland	9,000
Forest Land	-910,000	Forest Land	300,000
Total	678,000	Total	1,574,000
Total Beneficial Effects	678,000	Total Adverse Effects	1,574,000
Net Effect	-896,000		

1/ WRC 1977 normalized prices were used to calculate value of production.
2/ 6-5/8 percent interest rate for ten year evaluation period.
3/ Includes $78,700 for Operation and Maintenance.

Selected Plan
Environmental Quality Account
Southeast Minnesota Tributaries Basin

Components		Measures of Effects	
A.	Areas of Natural Beauty	1.	The accelerated land treatment program will enhance the physical appearance of 262,490 acres of cropland, 2,840 acres of pasture, and 105,900 acres of forest land by the year 2000.
		2.	Enhances and improves management on 2,840 acres of pastureland and 105,900 acres of forest land.
		3.	Enhances landscape diversity and scenic beauty by converting 27,790 acres to permanent cover.
		4.	Reduces sediment deposition in waterbodies as a result of land treatment.
B.	Quality considerations of water, land, and air resources.	1.	Reduces the annual soil loss by 2.0 million tons on cropland, .1 million tons on pastureland, and by .3 million tons on forest land.
		2.	Reduces sediment yield to the basin streams by 164,000 tons by the year 2000.
		3.	Adequately protects 262,490 acres of cropland, 2,840 acres of pasture land, and 105,000 acres of forest land.
		4.	Reduces nutrient (N,P,&K) and pesticide levels in surface runoff waters.

Selected Plan
Environmental Quality Account (Contd.)
Southeast Minnesota Tributaries Basin

Components	Measures of Effects
	5. Reduces turbidity and sediment in basin streams.
	6. Converts 27,790 acres of marginal cropland to permanent cover.
	7. Reduces sediment accumulation in roadside ditches, culverts, lakes and drainage ditches.
	8. Reduces gross erosion on 146,450 acres below its long term tolerance level on cropland and forest land.
	9. Reduces average rate of erosion on cropland which exceeds long term tolerance from 14.2 T/A/YR. to 11.8 T/A/YR.
	10. Increases ground water recharge.
	11. Reduces peak floodwater runoff.
	12. Improves the vegetative quality of 2,840 acres of pasture-land and 105,900 acres of forest land.
C. Archeological, historical and geological resources.	1. Provides for surveys, preservation, or recovery of important cultural resources before construction of any USDA projects.
D. Biological resources and selected ecosystems.	1. Improves hunting opportunities by improving wildlife habitat on 371,230 acres.

Selected Plan
Environmental Quality Account (Contd.)
Southeast Minnesota Tributaries Basin

Components		Measures of Effects
		2. Improves the wildlife habitat quality of 262,490 acres of cropland, 2,840 acres of pastureland, and 105,900 acres of forest land by application of accelerated land treatment and management.
		3. Improves stream habitat for fish by reducing turbidity, biocides, and sediment.
E.	Irreversible Commitments of Resources	1. Diverts labor, fuel, and capital from other activities to construct and install the project measures.
		2. Requires approximately two percent increase in energy for agricultural production.

Selected Plan
Regional Development Account
Southeast Minnesota Tributaries Basin

Components	Measure of Effects		Components	Measure of Effects	
	Minnesota	Rest of Nation		Minnesota	Rest of Nation
Income:	(Average Annual) $ 1/		Income:	(Average Annual) $ 2/	
Beneficial Effects:			Adverse Effects:		
The value of increased output to users residing in the region.			The value of resources contributed from within the region to achieve the output.		
Added value of agricultural production from land treatment systems.			Land Treatment		
			Installation	708,300	865,700
Cropland	1,349,000	-	Total	708,300	865,700
Pastureland	239,000	-			
Forest Land	- 910,000	-			
Total	678,000	-			
Total Beneficial Effects	678,000		Total Adverse Effects	708,300	865,700
			Net Effects	- 30,300	-865,700

1/ WRC 1977 normalized prices were used to calculate value of production.

2/ 6-5/8 percent interest rate for ten year evaluation period.

Selected Plan
Regional Development Account
Southeast Minnesota Tributaries Basin

Components	Measure of Effects		Components	Measure of Effects	
	Minnesota	Rest of Nation		Minnesota	Rest of Nation
Employment Beneficial Effects:			Employment Adverse Effects:		
Increase in number and types of jobs.			Decrease in number and types of jobs.	None	-
Employment for land treatment construction.	64 Semi-skilled jobs for 1 year	-			
Agricultural Employment required to produce added output.	200 Semi-skilled jobs	-			
Total Beneficial Effects	264 Semiskilled jobs		Total Adverse Effects	None	-

Selected Plan
Social Well-Being Account
Southeast Minnesota Tributaries Basin

Components		Measure of Effects	
Beneficial and Adverse Effects:			
A.	Real Income Distribution	1.	Creates 264 medium income jobs for area residents.
		2.	Puts $865,700 into the regional economy annually from the construction of proposed land treatment measures.
		3.	Cause redistribution of income among landowners due to shifts in agricultural production resulting from the accelerated land treatment program.
B.	Life, Health, and Safety	1.	Improves surface and subsurface water quality.
		2.	Reduces air pollution by reducing wind erosion.
C.	Education, cultural, and recreation.	1.	Improves fish and wildlife habitat for fishing and hunting opportunities.

Environmental Assessment Summary

This Environmental Assessment Summary discusses the effects associated with implementation of the selected plan.

Environmental Impacts

The accelerated land treatment program on 262,490 acres of cropland, 2,840 acres of pastureland, and 105,900 acres of forest land will reduce soil loss in the basin by over 2.5 million tons annually and increase land adequately protected by 371,230 acres by the year 2000. The resulting reduction in erosion, sedimentation, nutrient and biocide levels would improve water quality and stream habitats for fish. Improvements in wildlife habitat quality, scenic beauty, pasture and forest production, and overall environmental quality would also result.

Approximately 27,790 acres of cropland will be converted to permanent cover and wildlife habitat, foregoing the benefits of intensive use for crop production.

Unavoidable Adverse Environmental Effects

Installation of terrace on 38,790 acres of cropland may cause temporary adverse environmental effects.

Alternatives

A variety of alternatives were considered which are displayed in Chapter V.

Short-Term vs Long-Term Use of Resources

The basin economy is based on the production of agricultural products. The selected plan stresses preservation and conservation of the resources that make this economy possible --soil and water.

This plan was developed using environmentally and economically feasible alternatives. No changes in land use are proposed or anticiapted that will restrict options for future uses.

Irreversible or Irretrievable Commitments of Resources

Labor, fuel, and capital will be required to construct and install the plan recommendations, and thus will be irretrievably diverted from other activities.

Relationship to Land Use Plans and Policies

The Southeast Minnesota Regional Development Commission has developed a Growth and Development Policy Plan which states the Commission's position on land use and development in the region. Policies expressed in their plan are oriented toward obtaining desirable land use patterns with respect to location and density of development. The Selected Plan in this report does not propose any elements that will conflict with the policy or planned land use of the Southeast Minnesota Regional Development Commission.

CHAPTER IV

WATER AND RELATED LAND RESOURCE PROGRAMS

Introduction

A variety of programs provide technical and financial assistance to develop water and related land resources. These programs are administered by a number of state and federal agencies. This chapter discusses some of these programs and agencies that have responsibilities in resource development. Many of these agencies maintain county or regional offices in the basin. More information about specific programs can be obtained by contacting the responsible agency.

The level of land treatment needed for land and water resource protection will not be achieved by the on-going program or projected trend. To achieve the level of development recommended in the Selected Plan will require the cooperation of landowners and farm operators and additional assistance from all levels of government. It is recommended that the Selected Plan be implemented to the degree possible through an acceleration of existing programs. Local governments and organizations should have primary responsibility in plan implementation.

The Selected Plan recommends an acceleration of land treatment. Those agencies and organizations that provide technical and financial assistance for land treatment measures should be involved in implementing this plan. Briefly, these agencies and primary responsibilities are:

1. Soil Conservation Service - Technical Assistance

2. Agricultural Stabilization and Conservation Service - Cost-Sharing Program on Conservation Measures

3. USDA Forest Service - Technical Assistance

4. Farmers Home Administration - Loan Programs

5. Soil and Water Conservation District - State Cost-Share Program

6. Minnesota Department of Natural Resources - Technical and Financial Assistance.

In making use of the assistance these and other agencies can provide, the initiative in requesting assistance, rests primarily with the local individual or sponsoring group or organization. More information on these and other agencies and programs are discussed on the following pages.

U. S. Department of Agriculture

Agricultural Stabilization and Conservation Service (ASCS)

Agricultural Conservation Program:

The ASCS administers the Agricultural Conservation Program which provides financial assistance to individual farmers for installing needed soil, water, forestry, and wildlife conserving practices. Through this program, the Federal Government shares costs with farmers in establishing permanent protective cover, conserving and disposing of water, establishing forestry and wildlife conservation practices, protecting soil from wind and water erosion, and applying emergency conservation practices in designated disaster areas to control damage from floods and other natural disasters.

Water Bank Program:

The objectives of this program are to conserve surface water, preserve and improve migratory waterfowl habitat and wildlife resources, and secure other environmental benefits and agricultural production limitations. This program is available to landowners and operators of specific types of wetlands in designated important migratory waterfowl nesting and breeding areas.

Agreements are for ten years with eligible landowners to help preserve important breeding and nesting areas for migratory waterfowl. During the agreement, the participants agree in return for annual payments not to drain, burn, fill or otherwise destroy the wetland character of such areas and not to use areas for agricultural purposes.

Forestry Incentives Program:

The purpose of this program is to increase the supply of timber primarily to meet demands for construction materials through a combination of public and private investments on the most productive sites on eligible individual or consolidated ownerships of efficient size and operation.

This program is available to a private individual, group, association, corporation, or other legal entity which owns "nonindustrial" private forest lands capable of producing industrial wood crops. Cost-sharing of up to 75 percent of the total cost is available under the Forest Incentive Program for two forestry practices: tree planting and timber stand improvement. Only owners of nonindustrial private forest lands of 1,000 acres or less, capable of producing industrial wood crops are eligible for cost-sharing. In order for an individual within a county to receive funds, the county must be designated as a Forestry Incentives Program county by the ASCS state committee in consultation with the state forester. Houston, Fillmore, Wabasha, and Winona are designated FIP counties in the basin.

Rural Clean Water Program (RCWP):

The purpose of this program is to install and maintain best management practices to control agricultural non-point source pollution for improved water quality. RCWP is only applicable to privately owned land. Any landowner or operator whose land or activities in a project area is contributing to the area's agricultural non-point source water quality problems and who has an approved water quality plan is eligible to enter into a RCWP contract.

Farmers Home Administration

The Farmers Home Administration provides technical, management, and credit assistance to rural landowners and communities.

Of particular importance in the SEMT Basin are farm ownership loans, financial assistance to small towns and rural groups, and loans for recreational purposes. Farm ownership loans are used for a variety of purposes, including providing basic soil treatment and land conservation measures and providing necessary water and water facilities. Financial

assistance to small towns and rural groups is primarily for the planning and development of domestic water supply and waste disposal systems.

Loans are provided to operators of family farms for purposes of development of land and water resources, construction and repair of buildings, land and equipment purchase, and payment of operating expenses. Loans are also made to local sponsors for their share of PL-566 and RC&D projects cost.

These services can assist financially in solving problems identified with sediment and erosion control, waste disposal, and can contribute to the development of recreational facilities.

USDA Forest Service

Cooperative Forestry Assistance Act of 1978, P.L.95-313:

Cooperative forestry programs are administered by the Minnesota Department of Natural Resources in cooperation with the USDA Forest Service. Assistance provided through these programs are, the production and distribution of tree seedlings, technical assistance for forest management, technical assistance to improve production and utilization (to local forest product industries), insect and disease management, and fire control. Technical assistance is provided for the forestry measures of the Agricultural Conservation Program and the Forestry Incentives Program. The cooperative programs of the USDA Forest Service in the fields of watershed management, forest management, forestation, forest fire control, and insect and disease control on State and privately owned forest land, provide direction and opportunity for protection, sound management, and wise use of the forest land in the basin.

Soil Conservation Service

Public Law 46:

Public Law 46 established the Soil Conservation Service (in 1935) and made SCS responsible for developing and carrying out a national program for conservation and development of land and water resources.

SCS works to integrate the planning of land use and the installation of land treatment measures, taking into consideration land capability and land use needs. SCS's technical staff is made up of members of various disciplines who work together to diagnose land and water resource problems and prescribe proper treatment and use.

Most on-the-land SCS assistance to landowners is channeled through local Soil and Water Conservation Districts. Conservation practices for which SCS has provided technical assistance in the basin include:

1. Conservation cropping systems
2. Critical area planting
3. Crop residue use
4. Drainage field ditches
5. Fishpond management
6. Grade stabilization structures
7. Grassed waterways
8. Agricultural Waste Management Systems
9. Conservation tillage
10. Pasture and cropland management
11. Ponds
12. Terraces
13. Stripcropping
14. Tile drains
15. Wildlife habitat management

These measures have lessened erosion, sedimentation and wet agricultural soil problems in the basin, resulting in increased agricultural yields, reduced crop and pasture damage and improved environmental quality. However, there are still many areas in the basin in need of this kind of conservation planning assistance.

Soil Survey:

SCS also administers the Soil Survey Program. Under this program the SCS surveys the Nation's soils, analyzes and classifies them, and prepares detailed soil maps. Soils are evaluated in terms of adaptability to various uses, behavior under different conditions, and productivity relative to management levels.

Soil Surveys are valuable in identifying the most suitable lands to develop or maintain in farms, timber, recreation, and other uses. Soil Surveys also help to identify potential problems related to building of roads and streets, septic field locations, building sites, high water tables, etc. The Soil Survey Status Map shows the current status of the soil survey in the basin.

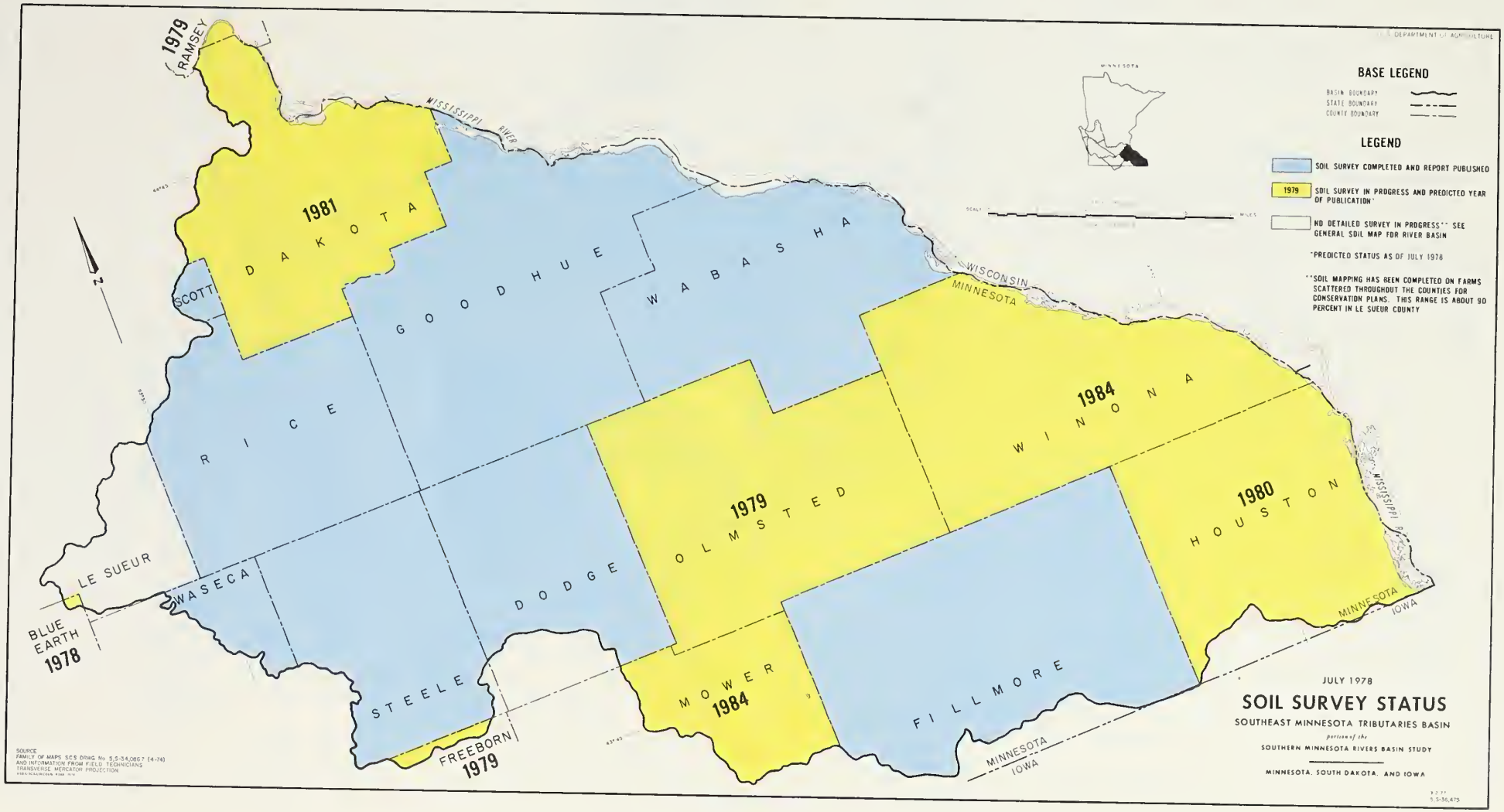
Public Law 566:

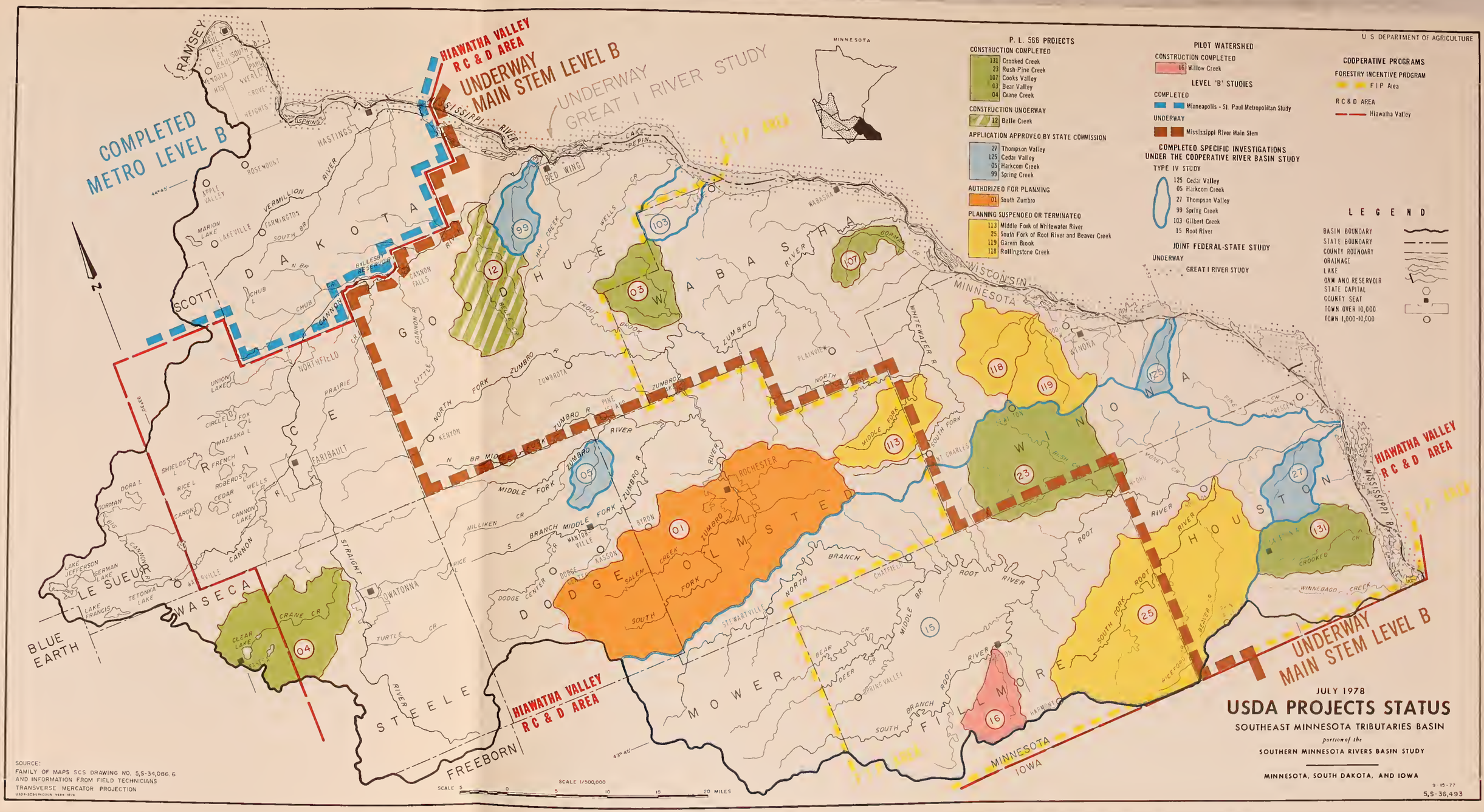
This law provides for technical and financial assistance to State and local organizations in planning, designing, and installing watershed works of improvement. The program provides opportunities for solving watershed problems not covered under existing programs. Cost sharing funds are available for flood prevention, drainage, irrigation, sedimentation control, fish and wildlife development, and public recreation. Through the Farmers Home Administration, long-term credit is available to finance the sponsor's portion of the cost.

At present, there are 15 P.L. 566 projects at various stages of development in the basin. The status of these projects is shown on the USDA Projects Status Map. The USDA Forest Service is responsible for the forestry phase of P.L. 566 projects and for soil and water conservation on forest lands.

Resource Conservation and Development Program (RC&D):

The RC&D Program was authorized by the Food and Agriculture Act of 1962. Its purpose is to stimulate economic growth in multi-county areas through accelerated conservation activities and land use adjustments. Under the leadership of the Soil Conservation Service, technical and financial assistance is provided to sponsors in carrying out eligible measures having community benefits. Eligible measures include: flood prevention, critical area treatment, land drainage, irrigation, public water-based recreation development, public water-based fish and wildlife development, and soil and water management for agricultural-related pollutant control. The


1979
RAMSEY
MISSISSIPPI RIVER
1981
DAKOTA
SCOTT
GOODHUE
WABASHA
WISCONSIN
MINNESOTA
RICE
1984
WINONA
1979
OLMSTED
1980
HOUSTON
MISSISSIPPI
LE SUEUR
WASECA
DODGE
MINNESOTA
IOWA
BLUE EARTH
1978
STEELE
MOWER
1984
FILLMORE
FREEBORN
1979
MINNESOTA
IOWA
BASE LEGEND
BASIN BOUNDARY
STATE BOUNDARY
COUNTY BOUNDARY
LEGEND
SOIL SURVEY COMPLETED AND REPORT PUBLISHED
1979 SOIL SURVEY IN PROGRESS AND PREDICTED YEAR OF PUBLICATION*
NO DETAILED SURVEY IN PROGRESS** SEE GENERAL SOIL MAP FOR RIVER BASIN
*PREDICTED STATUS AS OF JULY 1978
**SOIL MAPPING HAS BEEN COMPLETED ON FARMS SCATTERED THROUGHOUT THE COUNTIES FOR CONSERVATION PLANS. THIS RANGE IS ABOUT 90 PERCENT IN LE SUEUR COUNTY
JULY 1978
SOIL SURVEY STATUS
SOUTHEAST MINNESOTA TRIBUTARIES BASIN
portion of the
SOUTHERN MINNESOTA RIVERS BASIN STUDY
MINNESOTA, SOUTH DAKOTA, AND IOWA
SOURCE
FAMILY OF MAPS SCS DRWG No. S.S-34,086.7 (4-74)
AND INFORMATION FROM FIELD TECHNICIANS
TRANSVERSE MERCATOR PROJECTION


COMPLETED METRO LEVEL B
HIAWATHA VALLEY R C & D AREA
UNDERWAY MAIN STEM LEVEL B
UNDERWAY GREAT I RIVER STUDY
MINNESOTA
P. L. 566 PROJECTS
CONSTRUCTION COMPLETED
131 Crooked Creek
23 Rush-Pine Creek
107 Cooks Valley
03 Bear Valley
04 Crane Creek
CONSTRUCTION UNDERWAY
12 Belle Creek
APPLICATION APPROVED BY STATE COMMISSION
27 Thompson Valley
125 Cedar Valley
05 Harkcom Creek
99 Spring Creek
AUTHORIZED FOR PLANNING
01 South Zumbro
PLANNING SUSPENDED OR TERMINATED
113 Middle Fork of Whitewater River
25 South Fork of Root River and Beaver Creek
119 Garvin Brook
118 Rollingstone Creek
PILOT WATERSHED
CONSTRUCTION COMPLETED
16 Willow Creek
LEVEL 'B' STUDIES
COMPLETED
Minneapolis - St. Paul Metropolitan Study
UNDERWAY
Mississippi River Main Stem
COMPLETED SPECIFIC INVESTIGATIONS UNDER THE COOPERATIVE RIVER BASIN STUDY
TYPE IV STUDY
125 Cedar Valley
05 Harkcom Creek
27 Thompson Valley
99 Spring Creek
103 Gilbert Creek
15 Root River
JOINT FEDERAL-STATE STUDY
UNDERWAY
GREAT I RIVER STUDY
U S DEPARTMENT OF AGRICULTURE
COOPERATIVE PROGRAMS
FORESTRY INCENTIVE PROGRAM
F I P Area
R C & D AREA
Hiawatha Valley
L E G E N D
BASIN BOUNDARY
STATE BOUNDARY
COUNTY BOUNDARY
DRAINAGE
LAKE
DAM AND RESERVOIR
STATE CAPITAL
COUNTY SEAT
TOWN OVER 10,000
TOWN 1,000-10,000
HIAWATHA VALLEY R C & D AREA
UNDERWAY MAIN STEM LEVEL B
JULY 1978
USDA PROJECTS STATUS
SOUTHEAST MINNESOTA TRIBUTARIES BASIN
portion of the
SOUTHERN MINNESOTA RIVERS BASIN STUDY
MINNESOTA, SOUTH DAKOTA, AND IOWA
9-15-77
5,S-36,493
SOURCE:
FAMILY OF MAPS SCS DRAWING NO. 5,S-34,086.6
AND INFORMATION FROM FIELD TECHNICIANS
TRANSVERSE MERCATOR PROJECTION
SCALE 1/500,000
SCALE 5 0 5 10 15 20 MILES
RAMSEY
DAKOTA
GOODHUE
WABASHA
WINONA
OLMSTED
DODGE
FILLMORE
HOUSTON
MOWER
FREEBORN
STEELE
WASECA
LE SUEUR
BLUE EARTH
SCOTT
RICE
HASTINGS
RED WING
ROCHESTER
FARIBAULT
NORTHFIELD
OWATONNA
AUSTIN
LAKE PEPIN
MISSISSIPPI RIVER
WISCONSIN
IOWA

USDA Forest Service is responsible for the forestry phase of the RC&D program and for soil and water conservation on forest land.

The Hiawatha Valley RC&D area covers most of the basin. (See USDA Projects Status Map).

Inventory and Monitoring:

The objective of this program is to provide for the field collection, interpretation and publication of natural and related resource data. These data and interpretations serve many agencies and departments needs as well as those of individuals, groups, and units of government. They permit users to examine the relations and interactions of natural and related resources to determine how they are used, and how they are managed, to define resource problems, and to identify resource potentials.

Science and Education Administration (SEA):

The Science and Education Administration of the Department of Agriculture in cooperation with state land grant colleges and county governments provide education and information service for local groups and individuals. The Service is very active in the basin, combining research findings of the University of Minnesota and USDA to help people solve farm, home, and community problems.

Department of Defense

Corps of Engineers (COE)

Flood control responsibility within the Federal Government has been divided between the Department of Agriculture and the U.S. Army Corps of Engineers. USDA is responsible for upland treatment of the watershed and flood control through small structures. The Corps of Engineers is responsible for main stem activity.

The Corps of Engineers has the authority to plan and construct major reservoirs and local protection measures for navigation improvement, flood control, major drainage, hydroelectric power, water supply, and water quality control. The Corps has conducted flood and potential flood damage studies in the

basin which aid in planning for wise use of flood plains. Several basin projects are now in the planning process.

Flood Plain Management Service (FPMS):

The purpose of this program is to promote appropriate recognition of flood hazards in land and water use planning and development through the provision of needed information, technical services, and guidance.

Flood Control Projects (FCP):

This program purpose is to reduce flood damages through projects not specifically authorized by Congress.

Department of Interior

Fish and Wildlife Service (FWS)

The U.S. Fish and Wildlife Service is responsible for overall policies affecting fish and wildlife. The Service provides technical and financial assistance to State and local agencies in fish and wildlife management.

The Upper Mississippi National Fish and Wildlife Refuge, located along the Mississippi River from Lake Pepin south into Iowa and Illinois, is administered by the Fish and Wildlife Service.

Heritage Conservation and Recreation Service (HCRS)

Heritage Conservation and Recreation Service has responsibility for the coordination, planning, and promotion of outdoor recreation activities and provides financial support for outdoor recreation facilities at state parks, state preserves, and lakes and rivers. The Land and Water Conservation Program (LAWCON) provides funding for a wide range of outdoor recreation projects. The Minnesota Legislature determines the division of LAWCON funds between state and local governments.

United States Geological Survey (USGS)

The Geological Survey's broad mission is to enlarge the knowledge of the extent, distribution, character, and origins of the nation's natural resources and of the geologic processes that affect the use of them. It collects, analyzes, and publishes detailed information about the nation's mineral, land and water resources. Included in its responsibilities are topographic mapping, chemical and physical research, stream gaging and water-supply assessment, and supervision of mineral exploration and development activities on Federal and Indian lands. Much of its work is done in close cooperation with other Federal agencies and with State and local agencies.

Environmental Protection Agency (EPA)

Clean Lakes Program:

Since 1976, the U.S. Environmental Protection Agency has been awarding funds under the "clean lakes" section of the Clean Water Act. Costsharing grants have been made to rehabilitate or protect lakes. In addition to the "clean lakes" program, other parts of the Clean Water Act provide funding for activities related to lakes such as construction of sewage treatment plants and alternative waste management systems and area wide planning for waste water management.

State Agencies

Department of Natural Resources (DNR)

The DNR is assigned the responsibility of conserving and promoting the wise use of the natural resources of the state.

Principal responsibilities include:

1. Provide management assistance to private owners of forest land.

2. Acquire, develop, and maintain state parks, recreation areas, canoe and boating routes, wild and scenic rivers, and trail systems.

3. Protect and manage the state's wildlife and fish resources to assure sustained yields and an ample supply of game and fish.

4. Manage state-owned forest land.

5. Purchase and manage land in the Richard J. Dorer Memorial Hardwood State Forest.

6. Carry out state and local cooperative programs for management of flood plain and shoreland areas.

7. Administer the use, allocation and control of public waters of the state in order to conserve and utilize the water resources in the best public interest.

8. Promote financial and technical assistance for solving water and land related resource problems.

Soil and Water Conservation Board

The Soil and Water Conservation Board is housed within the Department of Natural Resources. They provide administrative and financial assistance to soil and water conservation districts in carrying out their programs for the conservation of soil and water resources. They administer a state cost-share program that allows a local soil and water conservation district to provide up to 75 percent funding for permanent erosion control practices with approved land occupiers. This cost-share program also provides for grants to control streambank, lakeshore, and roadside erosion.

In 1979 LCMR funded a pilot program that improves the ability of the DNR to provide technical assistance for private forest management. Through this program, southeast Minnesota will obtain four additional foresters. It also provides $100,000 cost-sharing for forestry practices in southeast Minnesota. This will be administered by the Soil and Water Conservation Board.

Southern Minnesota Rivers Basin Board

The Southern Minnesota Rivers Basin Board was created in 1971 to develop and implement a comprehensive plan for the watersheds of streams tributary to the Minnesota River and streams tributary to the Mississippi River south of its confluence with the Minnesota River at Fort Snelling in the Twin Cities. The major flood disasters of 1965 and 1969 highlighted the need for a plan based on the actual drainage area.

The Board cooperated with USDA as they conducted this Type IV study. They established a policy committee in southeast Minnesota to provide local input and guidance. They sponsored a series of public meetings and tours to provide information and receive comments about the direction of the study.

The Board is working in the Minnesota River Basin to implement its plan.

Minnesota Water Resources Board (MWRB)

The Water Resources Board is composed of members familiar with the water problems and conditions within the state. The purpose of the Board is to be a forum where the conflicting aspects of public interest involved can be presented and a controlling water policy be determined.

The Water Resources Board, upon the filing of a nominating petition, has the authority to establish watershed districts and to define and fix their boundaries. In addition, the Board has the authority to consider and make recommendations regarding questions of water policy when water conservation, water pollution, preservation and management of wildlife, drainage, soil conservation, public recreation, forest management, and certain municipal planning issues are involved.

Minnesota Pollution Control Agency (MPCA)

The Pollution Control Agency has the following powers and duties:

1. To administer and enforce all laws relating to the pollution of any waters of the state.

2. To investigate and gather data desirable in the administration and enforcement of the pollution laws.

3. To make such classification of the waters of the state as it may deem advisable.

4. To establish and alter such reasonable pollution standards for any waters of the state in relation to the public use for which they are or may be put.

5. To make and alter reasonable orders requiring the continuance of the discharge of sewage, industrial wastes, or other wastes, into any waters of the state resulting in pollution in excess of the applicable pollution standard.

6. To require to be submitted and to approve plans for disposal systems, and to inspect the construction thereof.

7. To issue, continue, or deny permits for the discharge of sewage, industrial wastes or other wastes, or for the installation or operation of disposal systems. Minnesota Statutes § 115.03.

Any of the permits issued by it, whenever necessary in the opinion of the agency could be revoked or modified. The agency was also empowered with the ability to prescribe and alter rules and regulations for the conduct of the powers granted to it, and to hold investigations and hearings as it deemed advisable. Minnesota Statutes § 115.03.

Minnesota Historical Society

The Minnesota Historical Society works to preserve archeological and historic sites. The Historical Society is interested in historic sites and landmarks of local, state, and national significance, and works with the Heritage Conservation and Recreation Service in designating national landmarks and historic sites.

Minnesota State Planning Agency

The Minnesota State Planning Agency administers critical area programs and provides technical, financial, and regulatory assistance. It is also responsible for planning for land use, water resources, parks, and open space.

Minnesota Department of Health

Responsibilities of the Department of Health in water resources management include environmental sanitation programs and inspection and evaluation of public and private water supplies.

Regional Development Commissions (RDC)

The Region Ten Development Commission was established in 1972 and includes almost the entire Southeast Minnesota Tributaries Basin. The responsibilities of the Commission are to:

1. Prepare and adopt a comprehensive development plan for the region.

2. Comment and make recommendations on long-term comprehensive plans submitted to it by each city, town, county, watershed district, and soil conservation district to determine the effect these plans will have on the development of the region.

3. Review all long-term comprehensive plans of each independent commission, board, or agency.

4. Contract with local units of government to provide them with planning and development services and technical assistance.

Local Organizations

Soil and Water Conservation Districts

Soil and Water Conservation Districts are legally constituted units of government created to administer soil and water conservation work within their boundaries. They sponsor or co-sponsor most Watershed Protection and Flood Prevention projects and Resource Conservation and Development projects. By virtue of their broad range of activities, districts play an important role in the development of rural areas.

These districts focus attention on land and water resources problems, develop annual and long-range programs designed to solve these problems, and enlist all available help from public and private sources to contribute to the accomplishment of the district's goals. They can provide state cost-share funds to land occupiers in accordance with their comprehensive plans.

Watershed Districts

These are legally established units of government created to carry out various authorities relating to water and land resources. Their Board of Managers must prepare an overall plan for their district which may include proposed work or projects. They can adopt rules and regulations and have taxing authority.

CHAPTER V
ALTERNATIVE PLANS

Introduction

The Water Resources Council's Principles and Standards (P&S) specify that the overall purpose of water and related land resource planning will be directed toward improvement in the quality of life through contributions to the objectives of national economic development (NED) and environmental quality (EQ).

Components of the NED objective are those that will enhance national economic development by increasing the value of the nation's output of goods and services and improving national economic efficiency. The environmental quality objective is enhanced by the management, conservation, preservation, creation, restoration, and improvement of the quality of natural and cultural resources and ecological systems.

The P&S provide the basis for federal participation with river basin commissions, states, and others in the preparation, formulation, evaluation, review and revision, and final transmittal to Congress of plans for states, regions, and river basins. In the discussion of alternative solutions and effects of these plans, the P&S are applied in far less detail than would be necessary for Implementation Studies. For the most part, alternatives are evaluated on a judgmental basis and the P&S are applied only to develop and evaluate alternative plans. Such detailed information as benefits, costs, and advanced engineering and design, that are necessary for implementation are general and should be used only to compare the relative effects of each plan.

Formulation of Alternative Plans

Six alternative plans were developed and presented to the local people for their consideration. These plans were

compared to the future condition that would exist without a project. Each plan represents a different combination of plan elements and thus has a different impact on identified problems.

Plan E was developed as the environmental quality plan. It includes a level of land treatment that would make the greatest improvement to the environment. Plan F is the national economic development plan and includes a level of land treatment that would have the greatest net monetary benefits. The plan elements contained in these two plans represent different levels of land treatment and resource protection measures.

Other plans were developed using different combinations and levels of land treatment and protective measures. All alternative plans show the effect different levels of land treatment will have on erosion and sediment, value of row crops, value of forage crops, production cost and income, plus incidental benefits to fish, wildlife, and recreation. Following is a description of each plan. Table V-1A, 1B, and 1C summarize each plan.

Future Without Plan

The future without plan is an estimate of future conditions which would exist if no federal or federally assisted water resources project, other than projects and programs already authorized and funded, were to be implemented.

By the year 2000, 55 percent of the erosive cropland soils, 50 percent of the wet agricultural soils, 48 percent of the pasture, and 43 percent of the forest land will be adequately protected. Gross erosion will be reduced from the present rate of 16.4 million tons per year, to 12.9 million tons. Sediment delivered to water bodies will be reduced from the present rate of one million tons per year to .8 million tons per year.

With the future without plan, 7,100 acres of critically erosive land will be converted to permanent cover. It is estimated that 126,500 acres of wet agricultural soils will have various levels of surface and subsurface drainage applied. Improvements to fish and wildlife habitat and improved recreation opportunities will result from the planned land treatment.

It is anticipated that two PL566 projects will be installed in the Future Without Plan. The South Zumbro Watershed involves works of improvement to be installed under authorities administered by the Soil Conservation Service and by the Army Corps of Engineers. The Soil Conservation Service responsibility includes the installation of six single purpose flood prevention structures, one multiple purpose flood prevention recreation structure, recreation facilities, and accelerated land treatment. The Army Corps of Engineers will administer the installation of channel work; levee construction; alterations of bridges, sewers, and utilities; and a river walkway corridor system. Installation of the planned project will reduce flooding on 2,700 acres of agricultural land and provide a one hundred year level of flood protection to the city of Rochester.

Installation of proposed measures will reduce flooding on about 1,870 acres in the Belle Creek Watershed. Structural measures to bring about the planned level of protection include five floodwater retarding structures and approximately a quarter mile of channel improvement.

Plan A

This plan is essentially the same as the Future Without Plan. However, greater emphasis is placed on treating forest land. Gross erosion rate will be 12.6 million tons per year and sediment delivery will be 798,000 tons per year.

Incidental benefits will accrue to fish and wildlife habitat and recreation. These benefits will result from the installation of the planned land treatment practices.

Plan B

Plan B increases the acres of forest land adequately protected by 98,900 acres. An additional 17,500 acres of wet agricultural soils will be drained. Gross erosion and sediment delivery rate will be 12.3 million tons per year and 798,000 tons per year respectively. Some increased incidental benefits will accrue to fish and wildlife habitat, recreation, and water quality as a result of increased land treatment practices.

Plan C

Plan C increases the acres adequately protected by 214,100 acres on cropland, 2,840 acres on pastureland and 89,400 acres on forest land. An additional 48,370 acres of wet agricultural soils will be drained. Critical areas converted to permanent cover will total 12,020 acres.

Gross erosion will be reduced by 1.3 million tons per year. Sediment delivery rate will be reduced by 93,000 tons per year.

Plan D

This plan was selected as the plan that would best solve the water and related land resource problems. Chapter III discusses this plan in detail.

Plan E (Environmental Quality Plan)

Plan E places greater emphasis on those plan elements that emphasize the protection and enhancement of the environment. It has the greatest effect on reducing erosion and sediment because it converts an additional 85,400 acres of critical areas to permanent cover.

This plan recommends that critical area stabilization be applied on 250 miles of streambank for erosion control. It also recommends that fish stream habitat improvement be applied to fifty miles of stream.

This plan will have positive effects on fish and wildlife habitat and will improve the resources available for recreation.

Plan F (National Economic Development Plan)

This plan was formulated to emphasize economic development. Because of the increased emphasis on production, this plan

is less effective for reducing erosion and sediment. This plan proposes draining an additional 48,370 acres of wet agricultural land with surface and subsurface drainage systems.

Table V-1A Summary of Alternative Plans Elements - Year 2000 1/

Southeast Minnesota Tributaries Basin

Plan Elements	Units	Future Without Plan	Plan A	Plan B	Plan C	Selected Plan D	EQ Plan E	NED Plan F
I. Land Treatment								
A. Cropland								
1. Contouring	Ac.	16,150	0	0	17,540	23,280	3,310	0
2. Stripcropping	Ac.	92,480	0	0	73,840	94,630	2,400	0
3. Terrace	Ac.	41,480	0	0	30,880	38,790	0	0
4. Permanent Cover	Ac.	7,100	0	0	12,020	27,790	85,400	0
5. Other Treatment	Ac.	105,490	0	0	79,820	78,000	0	0
Total		262,700	0	0	214,100	262,490	91,110	0
B. Pasture Management (establishment, reestablishment brush control & protection)	Ac.	2,160	0	0	2,840	2,840	4,840	3,840
C. Forest Land								
1. Woodland Grazing Control	Ac.	45,200	57,000	45,600	39,900	68,400	68,400	0
2. Tree Planting	Ac.	18,900	30,000	26,300	22,500	37,500	37,500	0
3. Timber Stand Improvement	Ac.	11,500	40,600	27,000	27,000	0	0	0
Total		75,600	127,600	98,900	89,400	105,900	105,900	0
D. Critical Area Stabilization for Streambank Erosion	Mi.	0	0	0	0	0	250	0
II. Drainage (Agricultural land)	Ac.	126,500	0	17,500	48,370	0	0	48,370
III. Structural Measures								
A. Floodwater Retarding Structure	No.	11	0	0	0	0	0	0
B. Multi-purpose Structure	No.	1	0	0	0	0	0	0
C. Grade Stabilization Structure	No.	2	0	0	0	0	0	0
D. Channel Work	Mi.	9.55	0	0	0	0	0	0
IV. Fish Stream Habitat Improvement	Mi.	2	0	0	0	0	50	0

1/ Each plan shows what will be accomplished above the future without plan.

Table V-1B Summary of Alternative Plans Effects - 2000

Southeast Minnesota Tributaries Basin

Area of Concern	Units	Future Without Plan	Plan A	Plan B	Plan C	Selected Plan D	EQ Plan E	NED Plan F
I. Gross Erosion 1/	Mil. Tons Per Year	12.9	12.6	12.6	11.6	10.5	9.9	12.9
II. Sediment Delivered	Tons/Yr.	823,500	798,000	798,000	730,500	659,500	629,500	813,500
III. Critical Areas (Class VI & VII) Changed to permanent cover 2/	Ac.	7,100	0	0	12,020	27,790	85,400	0
IV. Flooding - Agricultural land protected 3/	Ac.	4,570	0	0	0	0	0	0
V. Drainage	Ac.	126,500	0	17,500	48,370	0	0	48,370
VI. Fish and Wildlife Habitat								
A. Natural Areas and/or Wildlife Habitat Improvement 2/								
1. Conversion to Permanent Cover	Ac.	7,100	0	0	12,020	27,790	85,400	0
2. Improved quality, accelerated treatment & management								
a. Cropland	Ac.	255,600	0	0	202,080	234,700	5,710	0
b. Pasture	Ac.	2,160	0	0	2,840	2,840	4,840	3,840
c. Forest	Ac.	75,600	127,600	98,900	89,400	105,900	105,900	0
B. Fish Strem Habitat Improvement	Miles	2	0	0	0	0	50	0
VII. Recreation 2/								
A. Improve hunting opportunities with improved habitat	Ac.	340,460	127,600	98,900	306,340	371,230	201,850	3,840

1/ Annual erosion from cropland, pastureland, and forest land only.
2/ Incidental benefits to wildlife as a result of land treatment.
3/ Installation of measures will also provide a 100-year level of protection to the city of Rochester.

Table V-1C Economic Impact of Alternative Plans 1/

Southeast Minnesota Tributaries Basin

Items	Future Without Plan	Plan A	Plan B	Plan C	Selected Plan D	EQ Plan E	NED Plan F
	Annual 1,000 dollars						
I. Value of Production							
A. Value of row crops	338,571	-5,134	+3,209	+1,412	-1,837	-15,953	+7,378
B. Value of forage crops	116,377	- 895	-1,000	+2,972	+5,067	+ 5,620	- 393
C. Value of other crops 2/	42,246	0	0	0	0	0	0
Total all crops	497,194	-6,029	+2,209	+4,384	+3,230	-10,333	+6,985
D. Forage Value of Pasture	12,677	0	0	+ 241	+ 241	+ 411	+ 326
E. Forage Value of Grazed Forest	2,910	- 758	- 606	- 531	- 910	- 910	0
F. Flood Damage Reduction (Benefits)	965	0	0	0	0	0	0
Total of All Production 3/	513,746	-6,787	+1,603	+4,094	+2,561	-10,832	+7,311
II. Cost							
A. Crop Production Cost 4/	191,183	-1,578	+ 410	+1,190	+1,881	-4,029	+2,099
B. Pasture Production Cost	7	0	0	+ 2	+ 2	+ 8	+ 5
C. Land Treatment Cost							
1. Cropland 5/	5,138	-1,138	+ 518	+2,457	+1,265	-1,174	1,451
2. Pastureland	6	0	0	+ 9	+ 9	+ 14	+ 11
3. Forest Land	300	+ 400	+ 300	+ 200	+ 300	+ 300	0
Total	5,444	- 738	+ 818	+2,666	+1,574	- 860	+1,462
D. Structural Measures 6/							
1. Floodwater Retarding Structure	688	0	0	0	0	0	0
2. Multi-purpose Structures	389	0	0	0	0	0	0
3. Grade Stabilization Structures	23	0	0	0	0	0	0
4. Channel Work	3,952	0	0	0	0	0	0
E. Streambank Stabilization	0	0	0	0	0	20	0
F. Fish Stream Habitat Improvement	1	0	0	0	0	91	0
Total Project Cost	201,687	-2,316	+1,228	+3,858	+3,457	-4,770	+3,566
Net Effect	312,059	-4,471	+ 375	+ 236	- 896	-6,062	+3,745

1/ Plans A thru F show changes in relation to the going program.
2/ Includes oats and other small grains, vegetables, and specialty crops.
3/ Price Base - 1977. WRC normalized prices were used to calculate value of production.
4/ Includes purchased inputs items of seeds, fertilizer, machine operation, labor at 1977 prices. It does not include land or management cost.
5/ Includes cost of tile drainage.
6/ Construction cost was amortized at 6 5/8 percent for 100 years.
*Production cost for forestland was not computed.

APPENDIX A

SOUTHERN MINNESOTA RIVERS BASIN BOARD'S RECOMMENDATIONS

The Southern Minnesota Rivers Basin Board's enabling legislation clearly highlights the emphasis and importance placed on problems recognized in the basin. Therefore, the objectives of the Southern Minnesota Rivers Basin Board have been to direct the investigation of water and related land resource problems, balance their seriousness and basin-wide impacts, seek local citizen reaction and participation, and develop a plan based on the basin needs and economic feasibility.

The following recommendations should be considered at all levels of government when attempting to solve identified problems. Agencies that have responsibilities in a specified area should consider the recommendations listed in this appendix and Chapter III when considering solutions to problems in their area of expertise.

The recommendations listed below are an extension of Chapter III. These recommendations include a range of measures as well as recommending improvements of existing laws and programs.

Recommendations For Reducing Erosion & Sediment

Recommendation No. One

There should be an accelerated rate of treating erosive areas with such practices as strip-cropping, terracing, permanent cover, and contouring. The selected plan, as described in Chapter III, is recommended.

Justification

A severe problem in the basin is sheet and rill erosion on cropland that is cultivated and lacks proper management techniques. A major portion of the basin consists of areas with steep and erosive slopes. To reduce this erosion, there should be a concentrated effort to install practices designed to conserve the soil on these erosive areas.

Recommendation No. Two

The Minnesota Legislature should increase the funding for the Minnesota erosion cost-share program for placing permanent conservation practices on the land and controlling streambank, lakeshore, and roadside erosion.

Justification

The Minnesota Cost-Share program provides incentives for land occupiers to apply such practices as stripcropping, terraces, and waste control systems, for erosion control and improvement of water quality. It also provides for grants to control streambank, lakeshore and roadside erosion. Without these incentives many landoccupiers will not use these practices which are essential for reduction of erosion and sediment. There should be continued coordination with the federal cost-share program and emphasis on areas that are not funded in the federal program.

Recommendation No. Three

The Legislative Commission on Minnesota Resources (LCMR) should continue to fund the 12 year soil survey until completed.

Justification

A soil survey provides the necessary information to determine the proper uses of land within its capability. Developmental pressures have created situations where soils with unfavorable properties have been used for streets, septic tank absorption systems, and building sites, causing increased costs and pollution problems. Some of our most productive agricultural lands have been lost to development. It may also be used to equalize taxation between lands.

Recommendation No. Four

Area residents and governmental units should pursue various methods of special assistance to reduce the critical erosion problems in southeast Minnesota. These would include such programs as ASCS special projects, the Rural Clean Waters Program, or RC&D projects.

Justification

The Board recognizes there are critical erosion problems in southeast Minnesota. There are several existing programs that can be used to develop projects or other measures needed to improve severe erosive conditons. Local residents, officials, and agencies should work together to initiate the necessary projects.

Recommendations to Improve Water Quality

Recommendation No. One

Sinkholes should not be used as disposal sites, or for drainage outlets for feedlots. An intensive educational effort is needed to prevent this.

Justification

The southeast part of the state has a large area where a limestone formation is near the surface; this formation is susceptible to sinkholes. Water moves very quickly in this formation and water entering the surface in one place may reach nearby wells in hours or days with little, if any, purification by filtration. Any pollution entering a sinkhole presents a real hazard because of the direct relationship with the groundwater. There should be an intense informational program in this region to acquaint the residents with the hazard.

Recommendation No. Two

Land uses in the porous limestone area must be critically evaluated to prevent pollution of the ground water.

Justification

This limestone formation is very porous and is riddled with cracks and channels that provide a direct connection between the surface and ground water. Any contamination that occurs on the surface infiltrates and moves quickly through the limestone with only limited filtration.

Recommendation No. Three

Governmental Agencies should continue to study the complicated surface and ground water system in southeastern Minnesota.

Justification

Southeast Minnesota is a very complicated area hydrologically. In order to better plan for land uses in this area much more information about the ground and surface water relationships

is needed. During the 1980 - 1981 biennium LCMR is funding the Minnesota Geological Survey to study the subsurface geology and hydrology of this Karst region. In the 1977 - 1979 biennium studies were conducted by the College of Veterinary Medicine and the School of Public Health at the University of Minnesota, U. S. Geological Survey, and by the Minnesota Department of Health. Research on the health aspects was not completed and additional funding is necessary to carry on this work.

Recommendation No. Four

The Minnesota Water Quality Plan (208) should delineate the critical limestone areas and the highly erosive areas of southeast Minnesota and give these areas priority in planning and implementation.

Justification

A major source of water pollution in the basin is erosion from cropland. It is a pollutant in the form of sediment. The Karst (porous limestone) formation also needs special emphasis since contamination so readily enter and disseminates throughout the formation. The 208 Plan must recommend adequate management procedures. The plan must also prepare for accidents that can result in agricultural or industrial chemicals polluting the ground and surface water.

Recommendations for Land Use Control

Recommendation No. One

Local government is best suited to take the initiative in guiding growth. They should use their authority to adequately protect the natural resources.

Justification

Local government has the authority to regulate land and water use and sewer construction. Local government also provides major services such as schools, police and fire protection, and roads. The nature of growth varies so drastically between localities that the federal and state are not able to make specific local decisions.

Recommendation No. Two

Regional development commissions (RDC) should coordinate area development, local policies, and programs that are related to growth and land use on a regional basis. They should provide local government with the information needed to make rational growth decisions.

Justifications

RDC's should determine the impacts of development in a given locality for the whole region; local officials must recognize that to maintain a strong role in land use control, they must act in concert at the regional level.

Recommendation No. Three

The state of Minnesota should act to protect the overall interests of the citizens in the state with regard to land use, conservation of resources, and protection of the environment by the issuance of standards and guidelines for land use development and other aspects of growth.

Justification

With the increase in the scale of population settlements and the general mobility of population, the necessity for

state involvement in land use and growth decisions becomes both inevitable and desirable. The state can set standards and guidelines that relate to the overall needs of the state and, in general, outline the ways in which the needs are to be met; the specific decisions are left to local governments with input from the RDC's. The state has done this in several areas such as the Flood Plain and Shoreland Regulations.

Recommendation No. Four

Municipalities and counties should obtain technical assistance from their soil and water conservation district when evaluating various land use changes.

Justification

Municipalities often do not have the technical information to evaluate proposals for subdivisions, plats, or variances. The soil and water conservation districts - which blanket the state - can provide the technical soils information and its interpretation, needed by communities in making land use decisions.

Recommendation No. Five

Counties should adopt and carry out ordinances to protect valuable farm land from urban development.

Justification

Urban and rural conflicts are occuring in areas near Rochester and the Twin Cities. As development spreads from the urban centers valuable farm land is taken for residential, commercial and industrial growth. Small areas of urban development can influence agricultural land use on many acres around it. Some counties, such as Rice, have adopted ordinances that protect agricultural land from urban development. Ordinances are needed in all the counties to conserve valuable farmland.

Recommendation No. Six

Counties should adopt and enforce ordinances to prevent uncontrolled development.

Justification

Scattered uncontrolled residential, commercial, and industrial development in rural areas causes many problems which can be prevented by orderly annexation. Some counties, such as Rice, have developed ordinances that keep land adjacent to cities in agriculture until it can be annexed. This allows sufficient time to plan for placement of roads, sewers, and other needed services.

Recommendation No. Seven

Communities should adopt ordinances protecting the scenic Mississippi River bluff area.

Justification

The scenic Mississippi Rivers bluff area is a unique resource that needs protection. Second homes and other developmental pressures will continue to increase and communities need ordinances to adequately prepare for these pressures.

Recommendation No. Eight

Geologic information should be acquired before siting sanitary landfills or pipelines to avoid the Karst formation.

Justification

Contamination in the Karst (porous limestone) region poses a serious threat to a large area since water moves very rapidly throughout the system. Leaching from a landfill or leaks from a pipeline would pose a serious health hazard and water quality problem.

Recommendation No. Nine

Tax policy or incentive compensation should be used as a tool to implement or maintain the desired land use balance.

Justification

It is inappropriate to develop specific wetland, open space, flood plain, and land use policies without taking into consideration corresponding policies that relate to the value and taxation of the property. Appropriate assessment and taxation policies and incentives should be adopted to reduce and balance the impact of state standards and regulations.

The 1979 Omnibus Tax Act allows owners of certain wetlands a property tax credit. The state and federal waterbank programs also provide compensation for maintaining wetlands. Results of these measures should be evaluated to determine if they are adequate. If they work well they can be used as a model for other programs necessary to encourage specific land uses.

Recommendations To Improve The Forest Resource (See also Position Statement on the Memorial Hardwood Forest)

Recommendation No. One

The boundaries of the Richard J. Dorer Memorial Hardwood State Forest (as shown on the Minnesota Highway Map) should remain the same and the Department of Natural Resources and others

should promote the value of public and private forest lands in southeastern Minnesota. Local governments should be adequately reimbursed for state owned forest land.

Justification

The Southern Minnesota Rivers Basin Board supports the Memorial Hardwood Forest. The Board has adopted a position statement on the forest, provided information to the public about the forest at various meetings, and cosponsored a conference to inform citizens about the forest resources. Educational efforts must continue. When the public understands this program, they will want to have this valuable resource identified. The 1979 Omnibus Tax Act reimburses counties for taxexempt natural resource lands (including forest) within their boundaries. This should provide important revenue for local government with state owned forest land.

Recommendation No. Two

Incentives should be provided to encourage landowners to keep livestock from steep forested slopes.

Justification

Incentives are needed to encourage owners to keep cattle off steep and erosive slopes. The animals harm the site by causing severe soil compaction and by disturbing the soil's protective litter cover. As a result infiltration and percolation rates decrease, runoff and erosion volumes increase, nutrients are lost, and site productivity declines. This impairs the growth potential of the forest itself. In southeast Minnesota 270,000 acres or 45 percent of the forest is grazed.

Recommendation No. Three

Forest lands should be maintained and improved. A reforestation program should be established to replace essential forests on lands not suitable for agriculture. Since more than 90 percent of the forest land in the basin is privately owned, technical assistance and financial incentives are needed to encourage private forest owners to manage their forest land.

Justification

There is a need for increased technical assistance for private forest landowners. Currently the DNR only services three percent of these private landowners annually. In 1979, LCMR funded a pilot program that increased the technical assistance available for private forest management and also provides cost-sharing for forestry practices in southeast Minnesota. The SMRBB supports this approach. This program should be evaluated in 1981 and if successful continue as an on-going state program.

Recommendation No. Four

Forest lands should be protected by local zoning and subdivision regulations.

Justification

When southeastern Minnesota was first settled, steep valley slopes were overgrazed and trees were stripped for lumber. By the 1930's the village of Beaver had been buried by 12 feet of sediment. There is still a need today to protect the forested land from being cleared or improperly used.

Recommendations Concerning Wet Agricultural Soils

Recommendation No. One

The Minnesota legislature should provide incentive compensation and tax policies that are adequate to compensate private wetland owners for the public value of these lands.

Justification

The 1979 Omnibus Tax Act provides tax relief for owners of certain wetlands. This is important since one of the basic problems inherent in the drainage controversy is economics. This tax relief and the state and federal waterbank programs should be evaluated to see if they provide adequate compensation in comparison to the utility of the land for other purposes.

Recommendation No. Two

The Minnesota DNR and the counties should conduct an all out effort to complete the public waters classification.

Justification

The 1979 Legislature simplified the procedure for public waters classification in M.S. 105.391. It is now important for the counties and the DNR to work cooperatively to complete the classification as quickly as possible.

Recommendation No. Three

Recodify all Minnesota Water Laws into a comprehensible unit.

Justification

Minnesota Water Laws are confusing and contradictory and need clarification. This should be done in conjunction with the state water planning effort.

Recommendations For Reducing Flooding

Recommendation No. One

The plan for flood protection for the city of Rochester and the surrounding agricultural areas, proposed by the local sponsors with technical assistance from the Corps of Engineers and SCS, should be implemented.

Justification

SCS has developed a plan for watershed protection, flood prevention, and recreation and the Corps of Engineers has a flood control plan for the city of Rochester. The devastating flood of July 1978 in Rochester points out the need to reduce damages. It is also imperative that Rochester enforce flood plain regulations.

Recommendation No. Two

The state should provide adequate technical assistance to the counties and municipalities for development of sound flood plain ordinances.

Justification

To meet flood management goals, as well as nature's need to convey floodwaters, flood plain regulations should tightly control development in the flood plain. Municipalities and counties can best prepare for flooding by preventing

structural development in the flood plain; they need technical assistance to prepare their ordinances and for implementation.

Recommendation No. Three

Federal and state agencies should assist local units of government with non-structural methods of flood control and provide adequate funds for implementation.

Justification

Governmental flood control programs in the past have stressed structural means of reducing flood damages. There is a need for additional emphasis on programs that stress non-structural flood control measures including the provision of adequate funding for implementation.

Recommendation No. Four

The state subdivision law (Minnesota Statutes Chapter 394.25 for Counties and Chapter 462.358 for Municipalities) should be amended so that all counties and municipalities are required to adopt a policy which requires that erosion, sedimentation, and rate of runoff shall not be increased by development.

Justification

This will help prevent erosion and sedimentation problems in lakes and streams, and will also reduce downstream flooding problems in developing areas. It will require practices such as debris basins, holding ponds, diversions, temporary seeding, and stilling basins be installed during residential, commercial, and industrial construction.

Recommendation No. Five

Municipalities and Counties should develop an overall plan for flood protection that uses land use controls such as zoning, subdivision regulations, and building codes to prevent flood damage. Flood warning, forecasting, and emergency evacuation plans should be used to reduce flood damage.

Justification

There is no one answer to flood control, but an overall plan which uses the tools presently available can effectively assist a county or municipality in reducing flood damages.

Recommendations To Improve Fish and Wildlife Habitat

Recommendation No. One

The DNR should make projections outlining habitat needed to support a stable fish and wildlife community.

Justification

Too often valuable habitat is lost because there is a lack of understanding of the impacts certain land uses will have on the fish and wildlife resource. Therefore, it is necessary that there be (1) an inventory of physical and biological resources, (2) estimates of future demand on these resources, (3) a plan for development to satisfy the demand and still maintain the resource, and (4) public education efforts. Monies should be made available to implement the plan.

Recommendation No. Two

The private landowner should be encouraged to maintain habitat that will support wildlife populations.

Justification

The loss of woodlots, windbreaks, and brush cover between and within cropland fields, coupled with overgrazing, burning and improper management have reduced the quality of woodland habitat. To encourage habitat on private land, the landowner should receive a suitable return on his investment. The state and federal waterbank program should provide adequate compensation in comparison to other land costs, and other programs should be promoted that offer technical assistance and cost-sharing.

Recommendation No. Three

The DNR should work with the private landowner to manage private and public habitat for wildlife.

Justification

Wildlife habitat should be improved by establishing vegetative diversity. Such diversity should provide a range of vegetation types from grasses to trees and be distributed in a manner which provides a variety of vegetative types. These patterns of interspersed vegetation can only be achieved with full cooperation between wildlife agencies and private landowners who control the majority of land.

Recommendation No. Four

Where habitat is inundated, drained, filled or otherwise made unavailable to wildlife, similar habitat should be provided equal to the magnitude of the loss.

Recommendation No. Five

There should be better communications between the public, federal, and state conservation agencies, and between agencies

with varying or conflicting interests to insure that the basin's natural resources remain.

Recommendation No. Six

The springs that feed trout streams should be protected from pollution.

Justification

A complicated ground and surface water drainage system exists in portions of the basin. A spring can be fed by several surface water drainage systems. If the water feeding the spring is polluted, this polluted water will ultimately destroy the stream for trout and other aquatic habitat.

Recommendations To Assure Ample Water Supply

Recommendation No. One

The state should have a complete inventory of all ground and surface water: its use should be monitored to insure that the quality and quantity of each system is maintained.

Justification

The SMRBB initially recognized the need for good ground and surface water data. The board supported the development of a data system by the DNR and Minnesota Geological Survey which was funded by the 1977 legislature. The board continues to support the development of this data base.

Recommendation No. Two

Research should be continued to determine the pattern and sources of contamination of groundwater in southeastern Minnesota.

Justification

Surveys indicate that water in a majority of private wells in the area is contaminated to some extent. More information is needed to locate the source of pollution and the polluted wells to adequately prepare a program of prevention and improvement.

Recommendation No. Three

Landowners should have a soil and water conservation plan for their land before they proceed with individual irrigation systems.

Justification

A soil and water conservation plan developed by the local soil and water conservation district, which can include an irrigation water management plan, can help the irrigator determine practices important for soil and water conservation. The plan specifies 1) the water holding capacity of the soil, 2) the water demand of specific crops, and 3) the method of application and amount necessary.

Recommendations To Insure Adequate Recreational Opportunities

Recommendation No. One

State or local government should assure adequate accessibility to lakes and streams for all residents.

Justification

In an era where energy utilization is going to be a continuing problem, it will be necessary to locate recreation facilities in proximity to people rather than trying to move people to the most desirable resource areas.

Recommendation No. Two

Additional campsites should be provided in southeast Minnesota.

Justification

There is a need for additional campsites in southeast Minnesota and these can be provided by local, county or state government, or by the private sector.

Recommendation No. Three

Environmental corridors should be planned and constructed as an integral part of water resource development.

Justification

Environmental corridors can form the basis for future recreation development in rural areas and they can also isolate critical hydraulic, topographic, and vegetative features that need to be protected.

Recommendation No. Four

Watershed management, soil conservation practices, and practices to reduce urban runoff should be intensified as a means of reducing soil erosion and enabling the basin's water resources to improve their recreational potential.

Recommendation No. Five

To supplement acquisition programs, full use should be made of zoning, easements, leasing, deed restrictions, and other land use controls that provide possibilities for recreational opportunities.

Position Statement On The Memorial Hardwood State Forest

Note: This position statement was adopted by the SMRBB on May 3, 1978. Since then, the Minnesota Legislature passed the 1979 Omnibus Tax Act that reimburses counties for tax exempt land (including forests) within their boundaries; this should provide an important revenue source for local governments within the Richard J. Dorer Memorial State Hardwood Forest. The Legislative Commission On Minnesota Resources funded a two year pilot program starting July 1, 1979 for private forest management. The DNR will have four additional foresters in southeast Minnesota because of this program. It also provides $100,000 for cost-sharing for forestry practices in southeast Minnesota. The cost-sharing measures will be administered by the Soil and Water Conservation Board. The Southern Minnesota Rivers Basin Board supports these programs.

The Southern Minnesota Rivers Basin Board has spent a considerable amount of time learning about and discussing the Memorial Hardwood State Forest. Therefore, we strongly support the concept as outlined many years ago by Richard Dorer. We have been witnessing the controversy surrounding the evolution of this program, and suggest the following measures to help gain public acceptance.

An intensive public education effort is needed. This should help the public understand the benefits of a sound forest management program for the land and water resources of the area. It will also help the public to understand that the concept is not just acquisition, but that the acquisition is coupled with a plan that provides technical assistance for public and private forest lands and will benefit both.

Simultaneously, an increase in technical assistance should be provided to manage private and public woodlands. There are about two million acres of land within the Memorial

Hardwood Forest State boundaries. If the acquisition program reaches its original goal, ten percent of the land would be acquired. It is generally recognized today that it will be many years before even five percent is acquired. The key to the forest program has always been the private forest. Now is the time to emphasize and encourage it.

If the state adequately funded an intensive management program for private and public lands, the private sector would realize the benefits of being included in the Memorial Hardwood State Forest boundaries. This is currently not being done. For example, Houston County has 120,000 acres of forest and presently they have only one forester. He cannot possibly provide management assistance for all of the forest lands.

Not only will additional technical assistance demonstrate the value of good forest management, but it will assist the private forest owner in getting a fair price for his products. Presently some forest owners receive low prices because they are unaware of the value of their timber. In addition the public lands should be managed to demonstrate good woodland management. Today there is marketable timber on public lands and there is not adequate staff to mark it for sale. Timber sales would return needed revenue to the counties and townships.

We believe the boundaries of the Memorial Hardwood State Forest should remain the same. By educating the public about the total forest concept, and by providing a meaningful program of intensifying management for private and public lands the residents will want to have this valuable resource identified.

The Southern Minnesota Rivers Basin Board is very interested in payments made to local governmental units through this program. We have studied the current compensation schedule and are interested in assisting in any way with efforts to develop alternative approaches for compensation of lands for the Memorial Hardwood State Forest.

It is up to the legislature to provide a new effort in the hardwood forest management. We urge funding the technical assistance necessary to vividly demonstrate to the people in southeast Minnesota that the program will benefit them by providing the forest management needed on private and public lands. We urge an educational effort that will truly explain the Memorial Hardwood State Forest concept.

APPENDIX B
UPSTREAM RESERVOIR STUDY

Introduction

This Appendix contains an inventory of water storage opportunities in upstream watersheds in the Southeast Minnesota Tributaries Basin. The information presented here was requested by the local people and developed by the Soil Conservation Service. The Appendix contains preliminary data on 240 potential reservoir sites with additional data on 203 of these sites which have floodwater storage capacity.

The purpose of this Appendix is to summarize the potential of upstream structures in the basin for floodwater storage and other beneficial uses. More intensive investigations should be made to substantiate topographic and geologic data before sites are selected for detailed planning and development. The inventory reflects only the physical potential for storage in the basin; economic justification of sites is not implied.

Study Procedures

Site Selection

Two hundred forty potential reservoir sites were selected for evaluation through studies of U.S. Geological Survey (USGS) topographic maps and from suggestions made by interested persons. In general, sites were limited to drainage areas of 100 square miles or less.

Significant effects on railroads, interstate highways, main state highways, cities, and concentrations of buildings were avoided in selecting sites. Individual farmsteads and other roads were not considered to be prohibitive factors.

Sites are numbered according to the SCS Conservation Needs Inventory watershed unit designations. For example, Cannon River tributaries begin with ten. The Root River tributaries begin

with 15. Locations of sites evaluated are shown on the accompanying Site Inventory Map.

Structure Study and Evaluation

Areas inundated and available storage for each site were determined from USGS topographic maps. A representative group of sites were investigated in detail to establish reservoirs storage requirements for floodwater detention. The tentative sites were then screened, and those considered to have adequate storage for floodwater detention were selected for further analysis.

Preliminary designs were made for 203 sites showing floodwater storage potential. Structure data appears in Table B-1. Since some of these are alternates on the same stream, use of certain sites would eliminate development of others. Reservoir storage includes sediment, temporary floodwater, and other beneficial uses. Sediment volume was estimated for a 100 year period. A minimum of two inches of runoff from the watershed was assumed for temporary floodwater storage.

All structures were assumed to have unregulated fixed spillways designed for at least moderate hazard conditions. Spillway discharges were kept low for the first inch of floodwater storage, and the maximum discharges were varied as required by available storage. A minimum vertical distance of two feet was assumed between the permanent pool and the emergency spillway elevation.

An analysis of the data given in Table B-1 was made to determine site potential for fish, wildlife, and recreation. Sites not considered adequate for flood prevention are shown in Table B-2. Although not investigated beyond a flood storage determination, some of these sites may be useful for other purposes. Suitability of individual sites was not determined for specific beneficial use. Table B-3 summarizes sites with potential for recreation, fish, and wildlife use.

Data Limitations

Despite the detail indicated in the reporting of surface acres, elevations, storage, and fill height, it must be emphasized that the data was obtained from computations based solely on USGS 7½ minute and 15 minute topographic maps. Field surveys were not made. It must be further emphasized that data reflects potential for development rather than actual design characteristics.

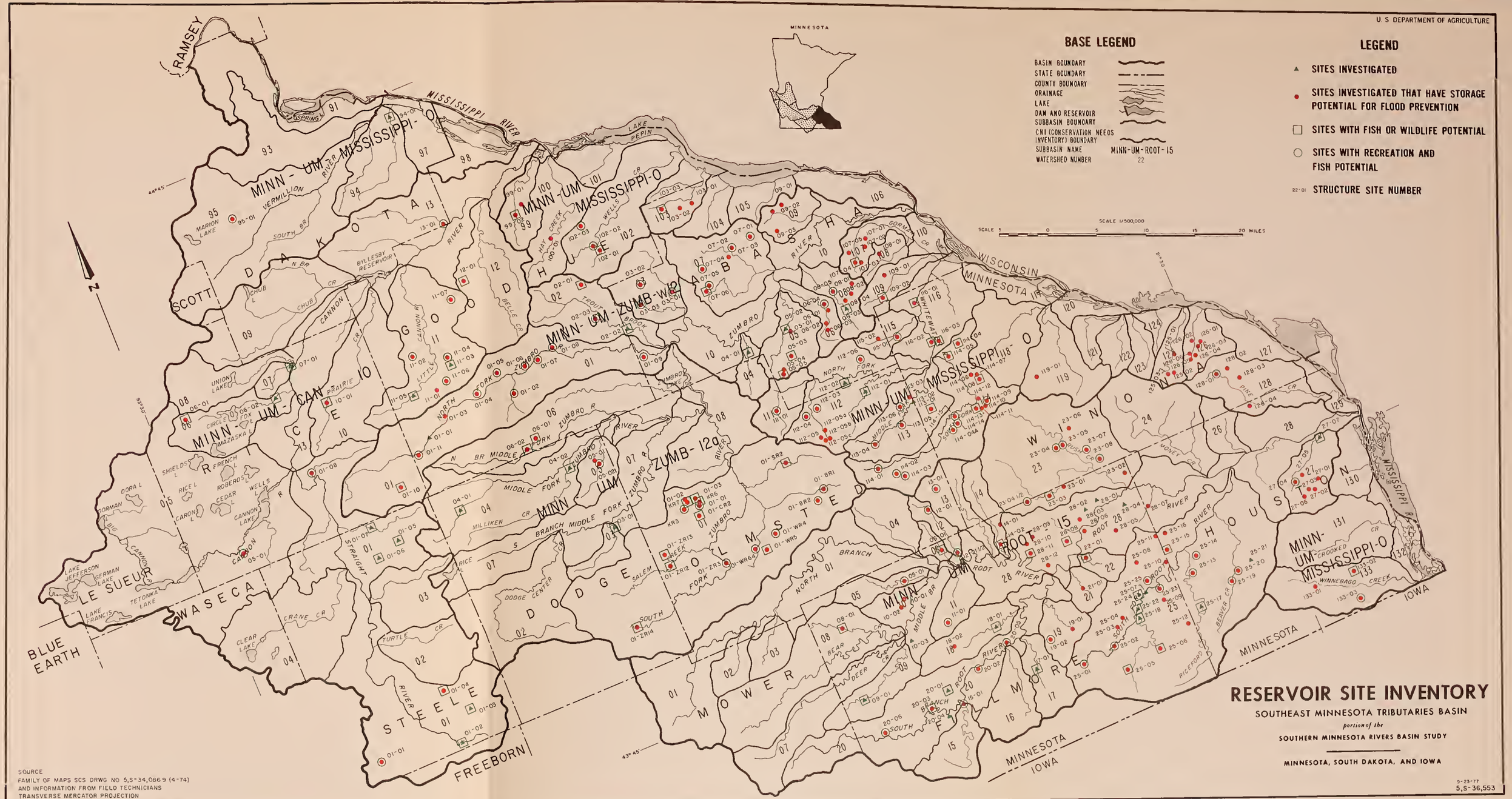

U. S DEPARTMENT OF AGRICULTURE
MINNESOTA
BASE LEGEND
BASIN BOUNDARY
STATE BOUNDARY
COUNTY BOUNDARY
DRAINAGE
LAKE
DAM AND RESERVOIR
SUBBASIN BOUNDARY
CNI (CONSERVATION NEEDS INVENTORY) BOUNDARY
SUBBASIN NAME MINN-UM-ROOT-15
WATERSHED NUMBER 22
LEGEND
SITES INVESTIGATED
SITES INVESTIGATED THAT HAVE STORAGE POTENTIAL FOR FLOOD PREVENTION
SITES WITH FISH OR WILDLIFE POTENTIAL
SITES WITH RECREATION AND FISH POTENTIAL
22-01 STRUCTURE SITE NUMBER
SCALE 1/500,000
SCALE 5 0 5 10 15 20 MILES
RAMSEY
SCOTT
DAKOTA
GOODHUE
WABASHA
WINONA
OLMSTED
DODGE
FREEBORN
STEELE
WASECA
LE SUEUR
BLUE EARTH
MOWER
FILLMORE
HOUSTON
WISCONSIN
MINNESOTA
IOWA
MISSISSIPPI RIVER
LAKE PEPIN
MINN-UM-MISSISSIPPI-01
MINN-UM-MISSISSIPPI-02
MINN-UM-VERMILLION RIVER-91
MINN-UM-CANNON-10
MINN-UM-ZUMB-WR2
MINN-UM-ZUMB-120
MINN-UM-ROOT-15
MINN-UM-CROOKED CREEK-WINNEBAGO CREEK-133
SOURCE
FAMILY OF MAPS SCS DRWG NO 5,S-34,0869 (4-74)
AND INFORMATION FROM FIELD TECHNICIANS
TRANSVERSE MERCATOR PROJECTION
USOA-SCS-LINCOLN, NEBR 1978
RESERVOIR SITE INVENTORY
SOUTHEAST MINNESOTA TRIBUTARIES BASIN
portion of the
SOUTHERN MINNESOTA RIVERS BASIN STUDY
MINNESOTA, SOUTH DAKOTA, AND IOWA
9-23-77
5,S-36,553

Table B-1 Structure Data for Potential Reservoir Sites for Flood Prevention and Multipurpose Use

Southeast Minnesota Tributaries Basin

Structure Site No.	Potent. Use	County	Location Tier/Range		Township	Section	Drainage Area (Sq.Mi.)	Elevation Top Dam	Elevation Em. Sp.	Total Storage (Acre-Feet)	Avail. (Inches)	Area Top Dam (Acres)	Area Em. Sp. (Acres)	Est. Max. Dam Ht. (Feet)
10-01-01	R	Steele	105N	21W	Berlin	26	3.3	1240	1235	813	4.6	433	187	25
10-01-04	FWL	Steele	105N	19W	Blooming Praire	6	3.8	1270	1266	790	3.9	189	124	25
10-01-08	R	Rice	110N	20W	Cannon City	33	12.0	1120	1115	3329	5.2	239	180	62
10-05-01	R	Rice	109N	22W	Morristown	26/25	7.2	1040	1035	1524	4.0	245	166	37
10-06-01	FWL	Rice	111N	22W	Erin	11	7.3	1050	1046	1507	3.9	533	414	20
10-10-01	FWL	Rice	111N	19W	Northfield	31	13.6	1010	1006	2062	2.8	287	244	23
10-11-01	FP	Goodhue	110N	18W	Holden	13	2.2	1090	1085	1148	9.7	66	56	61
10-11-02	R	Goodhue	111N	18W	Warsaw	26	2.8	1040	1035	1244	8.4	83	69	56
10-11-04	R	Goodhue	110N	17W	Wanamingo	6	4.0	1045	1040	2060	9.8	84	76	65
10-11-06	R	Goodhue	110N	17W	Wanamingo	18	3.7	1100	1095	1443	7.4	94	71	65
10-11-07	R	Goodhue	111N	17W	Leon	3	4.1	1050	1045	1270	5.8	90	76	50
10-12-01	F	Goodhue	112N	17W	Cannon Falls	36	1.9	1075	1070	799	8.0	56	48	55
10-13-01	R	Dakota	113N	17W	Douglas	36	27.2	800	795	5022	3.5	212	192	50
10 - Cannon R. Total							93.1			23011			1903	

Potential Use: FP - Flood Prevention, F - Fishing, WL - Wildlife, R - Recreation with Fishing

Table B-1 Structure Data for Potential Reservoir Sites for Flood Prevention and Multipurpose Use

Southeast Minnesota Tributaries Basin

Structure Site No.	Potent. Use	County	Location Tier/Range		Township	Section	Drainage Area (Sq.Mi.)	Elevation Top Dam	Elevation Em. Sp.	Total Storage Avail. (Acre-Feet)	Total Storage Avail. (Inches)	Area Top Dam (Acres)	Area Em. Sp. (Acres)	Est. Max. Dam Ht. (Feet)
12-01-02	R	Goodhue	109N	17W	Cherry Grove	1	5.4	1150	1145	1454	5.1	129	96	55
12-01-03	FP	Goodhue	110N	18W	Holden	35	2.5	1110	1105	411	3.1	35	26	44
12-01-04	R	Goodhue	110N	17W	Wanamingo	29	2.4	1110	1105	1258	10.0	152	114	34
12-01-05	R	Goodhue	110N	17W	Wanamingo	23	2.8	1095	1090	1466	9.9	116	96	48
12-01-06	R	Goodhue	110N	16W	Minneola	20	3.9	1080	1075	951	4.6	85	68	44
12-01-07	R	Goodhue	110N	16W	Minneola	28	8.5	1030	1025	1859	4.1	182	145	37
12-01-08	R	Goodhue	110N	16W	Minneola	23	2.5	1035	1030	1171	8.8	81	59	55
12-01-09	R	Wabasha	109N	14W	Mazeppa	7	4.4	940	935	743	3.2	63	52	45
12-01-10	WL	Rice	109N	19W	Richland	22	6.8	1200	1195	1123	3.1	174	120	33
12-01-11	R	Goodhue	109N	18W	Kenyon	18	2.5	1160	1155	758	5.7	65	53	52
12-02-01	WL	Goodhue	111N	15W	Goodhue	27	0.8	1124	1120	276	6.3	75	51	17
12-02-03	R	Goodhue	110N	15W	Zumbrota	15	3.7	1090	1085	1420	7.2	176	135	36
12-03-01	R	Wabasha	110N	14W	Chester	13	18.6	1000	995	3907	3.9	268	206	68
12-03-02	R	Wabasha	110N	14W	Chester	10	6.8	1055	1050	2844	7.8	197	167	55
12-03-03	R	Wabasha	110N	14W	Chester	16	6.3	1020	1016	2039	6.1	299	232	27
12-05-01	FP	Wabasha	109N	12W	Oakwood	27	4.9	1000	995	1364	5.2	72	61	80
12-05-03	F	Wabasha	108N	12W	Elgin	3	2.7	1050	1046	1123	7.7	88	74	50
12-05-04	FP	Wabasha	108N	12W	Elgin	8	1.9	1050	1046	603	5.9	45	38	47
12-05-05	F	Wabasha	108N	12W	Elgin	8	2.3	1050	1046	851	7.1	68	58	42
12-06-01	FP	Wabasha	109N	11W	Highland	29	0.8	1040	1036	339	8.0	39	30	40
12-06-02	FP	Wabasha	109N	11W	Highland	31	0.6	1085	1080	214	7.3	30	25	35
12-06-03	FP	Wabasha	109N	11W	Highland	31	0.8	1090	1085	328	8.2	39	28	45

Table B-1 Structure Data for Potential Reservoir Sites for Flood Prevention and Multipurpose Use

Southeast Minnesota Tributaries Basin

Structure Site No.	Potent. Use	County	Location Tier/Range		Township	Section	Drainage Area (Sq.Mi.)	Elevation Top Dam	Elevation Em. Sp.	Total Storage Avail. (Acre-Feet)	Total Storage Avail. (Inches)	Area Top Dam (Acres)	Area Em. Sp. (Acres)	Est. Max. Dam Ht. (Feet)
12-06-04	R	Wabasha	109N	11W	Highland	31	7.5	1060	1055	2098	5.2	126	106	60
12-07-01	R	Wabasha	110N	12W	West Albany	9	5.8	1050	1046	1853	6.0	130	112	50
12-07-02	R	Wabasha	110N	12W	West Albany	17	17.8	920	915	3090	3.2	131	118	66
12-07-03	FP	Wabasha	110N	12W	West Albany	18	1.1	1000	996	406	7.3	31	27	40
12-07-04	R	Wabasha	110N	13W	Gillford	15	3.4	1030	1026	1306	7.1	146	125	29
12-07-05	R	Wabasha	110N	13W	Gillford	22	1.0	995	990	458	8.4	51	41	32
12-07-06	F	Wabasha	110N	13W	Gillford	28	1.2	1004	1000	567	8.7	71	56	32
12-08-01	FP	Wabasha	109N	11W	Highland	23	1.4	1120	1118	240	3.2	25	23	34
12-08-02	FP	Wabasha	109N	11W	Highland	23	0.5	1120	1115	216	8.4	15	12	60
12-08-04	FP	Wabasha	109N	11W	Highland	27	0.4	1130	1125	169	7.2	23	16	45
12-08-05	R	Wabasha	109N	11W	Highland	16/21	16.2	910	905	5485	6.4	174	154	70
12-09-01	FP	Wabasha	111N	11W	Pepin	32	1.7	900	895	782	8.5	37	34	56
12-09-02	FP	Wabasha	111N	11W	Pepin	31	1.8	920	915	527	5.4	25	21	80
12-09-03	FP	Wabasha	110N	12W	West Albany	12	1.0	980	975	512	9.7	16	15	80
21 Total							152.7			44211			2794	

Potential Use: FP - Flood Prevention, F - Fishing, WL - Wildlife, R - Recreation with Fishing

Table B-1 Structure Data for Potential Reservoir Sites for Flood Prevention and Multipurpose Use

Southeast Minnesota Tributaries Basin

Structure Site No.	Potent. Use	County	Location Tier/Range		Township	Section	Drainage Area (Sq.Mi.)	Elevation Top Dam	Elevation Em. Sp.	Total Storage Avail. (Acre-Feet)	Total Storage Avail. (Inches)	Area Top Dam (Acres)	Area Em. Sp. (Acres)	Est. Max. Dam Ht. (Feet)
0-95-01	R	Dakota	114N	20W	Lakeville	14/23	3.9	960	956	953	4.6	185	127	30
0-99-01	FP	Goodhue	112N	15W	Featherstone	8	3.1	940	935	1267	7.7	44	40	80
0-99-02	F	Goodhue	112N	15W	Featherstone	18	5.4	920	915	1415	5.0	69	62	56
0-100-01	FP	Goodhue	112N	15W	Featherstone	33	14.8	995	990	2659	3.4	165	137	69
0-102-01	F	Goodhue	111N	14W	Belvidere	18	9.1	1055	1050	1560	3.2	61	55	77
0-102-02	R	Goodhue	111N	14W	Belvidere	7	5.2	1000	995	1077	3.9	52	46	66
0-102-03	R	Goodhue	112N	15W	Featherstone	36	3.5	1010	1005	1590	8.6	75	66	64
0-103-01	FP	Wabasha	111N	13W	Mt. Pleasant	11	1.2	870	865	511	8.2	26	24	70
0-103-02	FP	Wabasha	111N	13W	Mt. Pleasant	10	2.3	900	895	730	5.9	22	20	80
0-103-03	F	Wabasha	111N	13W	Mt. Pleasant	5	4.4	940	935	1440	6.2	69	58	68
0-107-01	FP	Wabasha	110N	10W	Greenfield	32	0.8	870	865	347	8.3	25	22	45
0-107-02	FP	Wabasha	109N	10W	Watopa	6	0.9	845	840	439	9.5	34	31	35
0-107-03	FP	Wabasha	109N	10W	Watopa	7	1.2	895	890	624	9.8	23	22	55
0-107-04	F	Wabasha	109N	11W	Highland	12	2.4	885	880	1169	9.1	52	44	50
0-107-05	FP	Wabasha	109N	11W	Highland	1	0.9	865	860	451	9.1	25	22	45
0-108-01	FP	Wabasha	109N	10W	Watopa	9	1.0	890	885	482	9.2	26	22	63
0-109-01	FP	Wabasha	109N	10W	Watopa	20	1.9	885	880	878	8.8	38	34	65
0-109-02	F	Wabasha	109N	10W	Watopa	31	6.4	940	935	2822	8.3	92	85	80
0-111-01	R	Olmsted	108N	13W	Farmington	35	6.6	1140	1134	1177	3.3	227	146	30
0-112-03	R	Olmsted	107N	12W	Viola	9	3.2	1145	1140	1511	8.8	107	88	43
0-112-04	R	Olmsted	107N	12W	Viola	8	5.9	1135	1130	2682	8.6	189	161	43
0-112-05	FP	Olmsted	107N	12W	Viola	21	0.9	1220	1215	450	9.8	35	29	45

Table B-1 Structure Data for Potential Reservoir Sites for Flood Prevention and Multipurpose Use

Southeast Minnesota Tributaries Basin

Structure Site No.	Potent. Use	County	Location Tier/Range		Township	Section	Drainage Area (Sq.Mi.)	Elevation Top Dam	Elevation Em. Sp.	Total Storage Avail. (Acre-Feet)	Total Storage Avail. (Inches)	Area Top Dam (Acres)	Area Em. Sp. (Acres)	Est. Max. Dam Ht. (Feet)
0-112-05a	FP	Olmsted	107N	12W	Viola	21	0.5	1205	1200	242	10.1	14	12	45
0-112-05b	FP	Olmsted	107N	12W	Viola	28	0.6	1235	1230	260	8.0	22	17	45
0-112-05c	FP	Olmsted	107N	12W	Viola	28	0.6	1220	1215	311	9.4	28	22	40
0-112-06	R	Wabasha	108N	11W	Plainview	27	5.5	1100	1095	2495	8.5	206	171	48
0-113-01	F	Winona	107N	10W	Elba	32	3.9	1100	1095	1744	8.4	125	100	65
0-113-03	FP	Winona	107N	10W	Elba	19	4.5	1035	1030	970	4.0	83	63	55
0-113-04	R	Olmsted	106N	11W	Dover	6	6.7	1160	1155	2747	7.7	185	160	43
0-113-05	R	Olmsted	106N	11W	Dover	2	8.8	1078	1074	1354	2.9	197	152	38
0-113-06	R	Olmsted	107N	11W	Quincy	26	3.4	1080	1075	1674	9.2	195	141	52
0-114-0	R	Olmsted	106N	12W	Eyota	24	3.6	1240	1236	868	4.6	126	96	30
0-114-02	R	Olmsted	106N	11W	Dover	20	2.8	1240	1236	950	6.5	92	75	40
0-114-03	R	Olmsted	106N	11W	Dover	28	3.4	1225	1220	1584	8.8	137	108	35
0-114-04	F	Winona	107N	9W	Norton	6	4.2	950	945	1592	7.2	54	49	80
0-114-04a	R	Winona	106N	10W	St. Charles	16	5.7	1135	1130	2873	9.5	366	253	47
0-114-05	F	Winona	107N	10W	Elba	11	8.6	830	825	2820	6.2	113	102	75
0-114-06	FP	Winona	107N	10W	Elba	24	6.1	880	875	1415	4.3	51	47	80
0-114-07	FP	Winona	107N	9W	Norton	29	0.7	1140	1135	284	7.2	21	16	40
0-114-08	F	Winona	107N	9W	Norton	32	2.0	1140	1135	958	8.9	89	72	40
0-114-09	R	Winona	106N	9W	Utica	8	6.9	1130	1125	3404	9.3	243	192	65
0-114-10	FP	Winona	106N	9W	Utica	7	0.8	1150	1145	394	9.9	43	29	50
0-114-11	FP	Winona	106N	9W	Utica	7	0.7	1145	1140	273	7.8	33	22	35
0-114-12	FP	Winona	106N	9W	Utica	6	9.5	1090	1085	1759	3.5	111	86	80

Table B-1 Structure Data for Potential Reservoir Sites for Flood Prevention and Multipurpose Use

Southeast Minnesota Tributaries Basin

Structure Site No.	Potent. Use	County	Location Tier/Range		Township	Section	Drainage Area (Sq.Mi.)	Elevation Top Dam	Elevation Em. Sp.	Total Storage Avail. (Acre-Feet)	Total Storage Avail. (Inches)	Area Top Dam (Acres)	Area Em. Sp. (Acres)	Est. Max. Dam Ht. (Feet)
0-114-13	F	Winona	106N	10W	St. Charles	12	2.0	1140	1135	1036	9.7	88	69	55
0-114-14	R	Winona	106N	10W	St. Charles	10	7.1	1120	1115	2117	5.6	216	168	42
0-114-15	R	Winona	106N	10W	St. Charles	10	13.6	1120	1115	6525	9.0	490	396	56
0-115-01	R	Winona	108N	10W	Whitewater	19	7.4	880	875	4287	10.8	125	118	80
0-115-02	FP	Wabasha	108N	11W	Plainview	24	6.0	960	955	984	3.1	34	31	76
0-116-01	F	Winona	108N	10W	Whitewater	10	2.8	760	755	944	6.2	57	48	60
0-116-02	F	Winona	108N	10W	Whitewater	34	5.1	800	795	2248	8.4	103	90	68
0-116-03	F	Winona	108N	10W	Whitewater	35	4.0	810	805	1897	8.9	77	69	78
0-119-01	FP	Winona	106N	8W	Warren	7	2.5	1010	1005	1244	9.3	42	39	72
0-125-01	FP	Winona	106N	6W	Homer	28	1.2	890	885	585	9.5	27	23	65
0-125-02	FP	Winona	105N	6W	Pleasant Hill	5	2.2	1040	1035	1020	8.9	31	30	80
0-125-03	FP	Winona	106N	6W	Homer	32	2.9	1020	1015	1236	8.1	75	62	65
0-126-01	FP	Winona	106N	6W	Homer	25	1.8	915	910	899	9.2	37	33	75
0-126-02	FP	Winona	106N	6W	Homer	26	0.7	870	865	363	9.6	18	15	70
0-126-03	FP	Winona	106N	6W	Homer	35	1.3	940	935	479	5.1	25	20	80
0-126-04	FP	Winona	106N	6W	Homer	2	1.1	980	975	311	5.3	16	13	80
0-126-05	FP	Winona	106N	6W	Homer	3	1.1	1005	1000	487	8.5	20	19	65
0-126-06	FP	Winona	106N	6W	Homer	34	0.9	975	970	353	7.4	18	13	75
0-128-01	R	Winona	105N	6W	Pleasant Hill	13	6.2	1020	1015	1923	5.8	76	68	80
0-128-02	FP	Winona	105N	5W	New Hartford	18	2.4	1020	1015	1151	9.0	36	32	76
0-128-03	FP	Winona	105N	5W	New Hartford	20	1.6	970	965	777	8.9	32	29	70
0-128-04	FP	Houston	104N	5W	Mound Prairie	4	1.5	850	845	701	9.0	30	27	70

Table B-1 Structure Data for Potential Reservoir Sites for Flood Prevention and Multipurpose Use

Southeast Minnesota Tributaries Basin

Structure Site No.	Potent. Use	County	Location Tier/Range		Township	Section	Drainage Area (Sq.Mi.)	Elevation Top Dam	Elevation Em. Sp.	Total Storage Avail. (Acre-Feet)	Total Storage Avail. (Inches)	Area Top Dam (Acres)	Area Em. Sp. (Acres)	Est. Max. Dam Ht. (Feet)
0-133-01	FP	Houston	101N	5W	Winnebago	17	2.0	875	870	991	9.5	36	34	75
0-133-02	FWL	Houston	101N	5W	Winnebago	13	1.9	820	815	932	9.2	44	41	60
0-133-03	R	Houston	101N	5W	Winnebago	26/35	3.2	815	810	1688	10.0	68	62	61
0 - Main Miss Direct T. Total							253.8			90621	6.7		4813	

Potential Use: FP - Flood Prevention, F - Fishing, WL - Wildlife, R - Recreation with Fishing

Table B-1 Structure Data for Potential Reservoir Sites for Flood Prevention and Multipurpose Use

Southeast Minnesota Tributaries Basin

Structure Site No.	Potent. Use	County	Location Tier/Range		Township	Section	Drainage Area (Sq.Mi.)	Elevation Top Dam	Elevation Em. Sp.	Total Storage Avail. (Acre-Feet)	Total Storage Avail. (Inches)	Area Top Dam (Acres)	Area Em. Sp. (Acres)	Est. Max. Dam Ht. (Feet)
15-05-01	R	Fillmore	104N	12W	Jordan	14	15.4	1100	1095	4726	5.8	204	180	75
15-06-01	F	Fillmore	104N	11W	Chatfield	3	4.0	1040	1035	911	4.2	85	65	48
15-08-01	F	Fillmore	104N	13W	Sumner	22	12.4	1240	1235	2385	3.6	92	83	76
15-10-01	FP	Fillmore	104N	12W	Jordan	27	3.0	1080	1075	1568	9.7	71	63	70
15-10-02	FP	Fillmore	104N	12W	Jordan	28	5.1	1120	1115	1444	5.4	80	67	70
15-11-01	R	Fillmore	103N	11W	Fountain	7	5.1	1240	1235	2294	8.4	285	199	48
15-12-01	R	Olmsted	105N	11W	Elmira	15	3.0	1135	1130	1249	7.9	109	93	35
15-12-01.5	R	Fillmore	104N	11W	Chatfield	11	12.5	1000	995	3902	5.9	134	123	80
15-13-01	R	Olmsted	105N	11W	Elmira	11	3.6	1155	1150	1847	9.6	103	88	45
15-14-01	FP	Fillmore	104N	10W	Pilot Mound	10	1.7	1090	1085	817	8.9	56	44	60
15-14-02	F	Fillmore	104N	10W	Pilot Mound	22	19.7	975	970	3261	3.1	125	113	80
15-15-01	R	Fillmore	102N	12W	Forestville	24	32.4	1130	1125	5506	3.2	174	161	73
15-18-02	FP	Fillmore	103N	11W	Fountain	30	1.4	1200	1195	453	6.0	30	25	60
15-19-01	FP	Fillmore	102N	9W	Amherst	7	2.2	1105	1100	919	7.7	65	54	47
15-19-02	R	Fillmore	102N	10W	Preston	11	7.1	1080	1076	1823	4.8	141	119	46
15-20-02	R	Fillmore	102N	11W	Carimona	7	5.6	1095	1090	2862	9.6	105	97	75
15-20-03	F	Fillmore	102N	12W	Forestville	21	61.6	1225	1220	10734	3.3	419	368	77
15-20-05	R	Fillmore	102N	11W	Carimona	1	3.1	1004	1000	704	4.2	52	43	44
15-20-06	R	Fillmore	102N	13W	Bloomfield	16	2.7	1325	1320	811	5.7	179	103	30
15-21-01	FP	Fillmore	103N	9W	Holt	28	2.8	980	975	887	5.9	39	34	72
15-22-01	F	Fillmore	103N	9W	Holt	11	7.8	880	875	2802	6.7	107	98	70
15-23-01	FP	Fillmore	104N	9W	Arendahl	1	1.4	995	990	671	9.1	23	21	75

Table B-1 Structure Data for Potential Reservoir Sites for Flood Prevention and Multipurpose Use

Southeast Minnesota Tributaries Basin

Structure Site No.	Potent. Use	County	Location Tier/Range		Township	Section	Drainage Area (Sq.Mi.)	Elevation Top Dam	Elevation Em. Sp.	Total Storage Avail. (Acre-Feet)	Total Storage Avail. (Inches)	Area Top Dam (Acres)	Area Em. Sp. (Acres)	Est. Max. Dam Ht. (Feet)
15-23-02	FP	Fillmore	104N	8W	Rushford	12	2.3	1000	995	883	7.3	37	35	63
15-23-03	F	Fillmore	104N	9W	Arendahl	3	27.0	1040	1035	4356	3.0	220	194	72
15-23-04	R	Winona	105N	8W	Hart	18	5.3	905	900	2166	7.7	64	61	65
15-23-04.5	R	Fillmore	104N	9W	Arendahl	5	4.6	1100	1096	978	4.0	87	72	44
15-23-05	R	Winona	105N	8W	Hart	18	37.0	910	905	8962	4.5	279	263	78
15-23-06	FP	Winona	105N	8W	Hart	8/9	7.4	1000	995	1706	4.3	54	50	86
15-23-07	R	Winona	105N	8W	Hart	21	5.9	940	935	2348	7.5	89	81	86
15-23-08	R	Winona	105N	8W	Hart	34	2.9	930	925	1755	11.2	54	51	80
15-25-01	R	Fillmore	102N	9W	Amherst	31	8.4	1150	1144	1665	3.7	176	140	33
15-25-02	R	Fillmore	102N	9W	Amherst	27	11.1	1080	1076	1295	2.9	148	119	38
15-25-03	FP	Fillmore	102N	9W	Amherst	23	2.3	1095	1090	1091	8.9	58	48	76
15-25-04	FP	Fillmore	102N	9W	Amherst	13	1.1	1100	1095	497	8.9	34	28	46
15-25-05	F	Fillmore	101N	9W	Canton	15	4.5	1165	1160	2270	9.6	110	93	64
15-25-06	F	Fillmore	101N	8W	Newburg	9	1.6	1125	1120	661	7.8	71	54	41
15-25-08	FP	Fillmore	103N	8W	Norway	28	2.7	1045	1040	1190	8.2	49	43	80
15-25-09	FP	Fillmore	102N	8W	Preble	23	1.9	1100	1095	889	8.7	34	31	74
15-25-10	FP	Fillmore	103N	8W	Norway	36	3.4	840	835	1327	7.4	54	49	80
15-25-11	FP	Fillmore	103N	8W	Norway	13	3.6	1120	1115	1356	7.1	78	66	72
15-25-12	FP	Fillmore	101N	8W	Newburg	2	1.9	1118	1114	847	8.6	58	49	51
15-25-13	R	Houston	102N	7W	Black Hammer	8	2.7	850	845	1241	8.5	49	46	70
15-25-14	R	Houston	102N	7W	Black Hammer	4	2.4	835	830	1096	8.5	52	45	70
15-25-15	F	Houston	103N	7W	Yucatan	30	2.3	855	850	1161	9.4	42	39	70

Table B-1 Structure Data for Potential Reservoir Sites for Flood Prevention and Multipurpose Use

Southeast Minnesota Tributaries Basin

Structure Site No.	Potent. Use	County	Location Tier/Range		Township	Section	Drainage Area (Sq.Mi.)	Elevation Top Dam	Elevation Em. Sp.	Total Storage Avail. (Acre-Feet)	Total Storage Avail. (Inches)	Area Top Dam (Acres)	Area Em. Sp. (Acres)	Est. Max. Dam Ht. (Feet)
15-25-16	FP	Houston	103N	7W	Yucatan	18	4.7	940	935	1156	4.6	41	39	75
15-25-19	R	Houston	102N	7W	Black Hammer	25	8.5	1020	1015	1305	2.9	53	48	80
15-25-20	R	Houston	102N	6W	Caledonia	19	10.8	935	930	3177	5.5	92	86	79
15-25-23	R	Fillmore	102N	8W	Preble	11	6.0	890	885	2063	6.4	82	72	80
15-25-25	R	Fillmore	102N	8W	Preble	3	8.1	870	865	1804	4.2	88	80	55
15-27-01	FP	Houston	103N	5W	Union	25	1.9	835	830	979	9.8	42	41	55
15-27-02	FP	Houston	103N	5W	Union	26	3.1	870	865	1335	8.0	63	53	70
15-27-03	FP	Houston	103N	5W	Union	26	3.1	880	875	1234	7.5	69	55	80
15-27-04	R	Houston	103N	5W	Union	21	4.5	930	925	2110	8.8	63	59	63
15-27-05	FP	Houston	103N	5W	Union	22	1.2	890	885	518	8.5	22	20	50
15-27-06	FP	Houston	103N	5W	Union	34	2.2	960	955	1052	8.9	37	34	80
15-28-03	FP	Fillmore	104N	9W	Arendahl	24	1.9	860	855	928	9.3	37	33	80
15-28-05	FP	Fillmore	103N	8W	Norway	4	2.9	935	930	1443	9.3	52	48	77
15-28-06	FP	Fillmore	104N	9W	Arendahl	36	1.6	860	855	584	6.7	24	22	70
15-28-07	FP	Fillmore	103N	8W	Norway	31	2.8	900	895	1113	7.6	37	36	80
15-28-08	F	Fillmore	104N	9W	Arendahl	34	5.8	860	855	2913	9.5	104	95	80
15-28-09	FP	Fillmore	104N	9W	Arendahl	19	1.3	1095	1090	670	9.5	38	32	60
15-28-10	FP	Fillmore	104N	10W	Pilot Mound	24	3.3	980	975	970	5.5	33	30	80
15-28-11	F	Fillmore	104N	10W	Pilot Mound	25	6.5	900	895	3050	8.8	103	94	75
15-28-12	FP	Fillmore	103N	9W	Holt	6	1.4	900	895	489	6.6	27	23	65
15 - Root River Total	64 Sites						437.5			121,209	5.2		4898	

Potential Use: FP - Flood Prevention, F - Fishing, WL - Wildlife, R - Recreation with Fishing

Table B-1 Structure Data for Potential Reservoir Sites for Flood Prevention and Multipurpose Use

Southeast Minnesota Tributaries Basin

Structure Site No.	Potent. Use	County	Location Tier/Range		Township	Section	Drainage Area (Sq.Mi.)	Elevation Top Dam	Elevation Em. Sp.	Total Storage Avail. (Acre-Feet)	Total Storage Avail. (Inches)	Area Top Dam (Acres)	Area Em. Sp. (Acres)	Est. Max. Dam Ht. (Feet)
12a-01-01	R	Olmsted	107N	15W	Kalmar	26	1.7	1110	1105	536	5.9	84	62	27
12a-01-02	FP	Olmsted	107N	15W	Kalmar	24	0.8	1110	1106	259	6.3	42	32	30
12a-01-03	F	Olmsted	107N	14W	Cascade	30	1.0	1080	1075	435	8.4	64	48	30
12a-01-BR1	R	Olmsted	106N	12W	Eyota	18	13.1	1180	1174	5617	8.1	369	280	69
12a-01-BR2	R	Olmsted	106N	13W	Marion	24	4.5	1178	1174	2405	9.9	121	109	54
12a-0-CR2	WL	Olmsted	106N	15W	Salem	1	16.4	1106	1098	5229	6.0	750	451	50
12a-01-KR3	R	Olmsted	107N	15W	Kalmar	26	1.6	1118	1114	590	6.7	84	65	30
12a-01-KR6	F	Olmsted	107N	14W	Cascade	29	1.6	1070	1065	566	6.6	105	71	32
12a-01-KR7	WL	Olmsted	107N	15W	Kalmar	25	3.8	1100	1095	1395	6.9	231	155	34
12a-01-SR2	WL	Olmsted	107N	13W	Haverhill	27	9.8	1185	1180	4109	7.9	354	290	59
12a-01-WR4	R	Olmsted	106N	13W	Marion	30	4.2	1135	1130	1586	7.1	179	139	43
12a-01-WR5	F	Olmsted	106N	14W	Rochester	35	4.0	1165	1160	1269	5.9	154	126	41
12a-01-WR6A	R	Olmsted	106N	14W	Rochester	34	9.5	1145	1140	3994	7.9	241	225	55
12a-01-ZR3	R	Olmsted	106N	14W	Rochester	31	72.7	1140	1135	37768	9.7	197	150	70
12a-01-ZR12	FWL	Olmsted	106N	15W	Salem	20	45.3	1180	1160	8980	3.7	538	358	80
12a-01-ZR13	FWL	Olmsted	106N	15W	Salem	17	5.6	1140	1136	2662	8.9	322	252	36
12a-01-ZR14	FWL	Dodge	105N	16W	Vernon	8	11.2	1268	1260	3533	5.9	515	324	42
12a-05-01	FP	Dodge	108N	16W	Milton	23	1.3	1144	1142	202	2.9	22	18	27
12a-05-02	R	Dodge	108N	16W	Milton	23	8.4	1140	1135	3012	6.71	275	217	45

Table B-1 Structure Data for Potential Reservoir Sites for Flood Prevention and Multipurpose Use

Southeast Minnesota Tributaries Basin

Structure Site No.	Potent. Use	County	Location Tier/Range	Township	Section	Drainage Area (Sq.Mi.)	Elevation Top Dam	Elevation Em. Sp.	Total Storage Avail. (Acre-Feet)	Total Storage Avail. (Inches)	Area Top Dam (Acres)	Area Em. Sp. (Acres)	Est. Max. Dam Ht. (Feet)
12a-06-01	F	Goodhue	109N 17W	Cherry Grove	36	1.4	1155	1150	672	8.9	53	43	40
12a-06-02	F	Goodhue	109N 17W	Cherry Grove	35	30.0	1140	1135	4655	2.9	408	334	42
12a - Zumbro R. Total						247.9			89474			3749	

Potential Use: FP - Flood Prevention, F - Fishing, WL - Wildlife, R - Recreation with Fishing

Table B-2 Other Sites Evaluated

Southeast Minnesota Tributaries Basin

Site No.	Potential Site Use	Drainage Area	Storage Available (Ac. Ft.)	(Inches)
0-94-01	F	25.6	247	1.82
0-112-01	F	13.4	1397	1.95
0-112-02	F	5.13	237	.87
0-113-02	U	33.4	99	.56
10-01-02	WL	12.4	437	.66
10-01-03	WL	16.4	785	.90
10-01-05	FWL	3.5	352	1.91
10-01-06	WL	5.2	187	.68
10-01-07	WL	17.8	1499	1.58
10-06-02	FWL	42.5	1957	.86
10-07-01	F	8.7	664	1.43
10-11-03	F	6.4	277	.81
10-11-05	F	12.3	400	.61
12-01-01	U	5.9	159	.51
12-02-02	F	48.9	4045	1.55
12-04-01	F	11.4	745	1.22
12-05-02	F	17.6	473	.51
12-08-03	FWL	9.0	703	1.5
12a-03-01	F	10.9	808	1.4
12a-04-01	F	13.4	972	1.4
12a-04-02	F	31.1	2953	1.8

Table B-2 Other Sites Evaluated

Southeast Minnesota Tributaries Basin

Continued

Site No.	Potential Site Use	Drainage Area	Storage Available	
			(Ac. Ft.)	(Inches)
15-09-01	F	9.8	856	1.6
15-10-03	U	3.8	529	2.6
15-17-01	F	10.3	1413	2.6
15-18-01	F	21.8	2784	2.4
15-20-01	F	15.9	2240	2.6
15-20-04	U	5.2	716	2.6
15-25-07	U	95.0	9853	1.9
15-25-17	F	42.5	4534	2.0
15-25-18	F	43.8	5952	2.6
15-25-21	U	7.3	926	2.4
15-25-22	F	76.5	7149	1.8
15-25-24	F	13.5	675	.9
15-27-07	FWL	26.0	1167	.8
15-28-01	U	1.3	102	1.5
15-28-02	U	2.6	244	1.8
15-28-04	U	2.2	239	2.0

Potential Use: FP - Flood Prevention, F - Fishing, WL - Wildlife, R - Recreation, U - Unsuitable for the above uses.

Table B-3 Reservoir Sites With Recreation, Fish, and Wildlife Development Potential*
Southeast Minnesota Tributaries Basin

	Acres	No. of Sites
Recreation and Fishing	9,566	78
Fishing Only	3,057	33
Wildlife Only	1,067	5
Fish or Wildlife	1,757	7
Fishing (Total)	14,380	118
Wildlife (Total)	2,824	12

*Note: Only those sites with flood control feasibility were evaluated for multiple use. Many noninventory sites would have single purpose potential (especially for wildlife developments).

Evaluation Criteria

Recreation - Minimum of 50 acres of permanent pool and 10' depth above sediment pool.

Fishing - 12'-15' minimum total depth and 50 acres of pool. Judgment was used on some sites where drainage area and ratio of deep to shallow water were potentially limiting factors.

Wildlife - 12' maximum depth with judgment used on sites where ratio of deep to shallow water were potentially limiting factors. Dam height 20' or less, 25 acre minimum.

APPENDIX C
SOIL INFORMATION

Soil Associations

The General Soils Map shows the soil associations in the basin. A soil association is a geographic area of two or more kinds of soils that occur together in some regularity of pattern. Every area of an association contains the same soils but the proportion may differ. Associations are named for the major soils. The soils in one association may occur in another, but the major soils are different.

The General Soils Map, and accompanying descriptions, can be used to obtain a general knowledge of the soils in the basin. The map and description provide a general guide for making broad land use and management decision for planning watersheds, wildlife areas, engineering works, recreational facilities, and community developments. The map is not suitable for detailed planning of land use and management of a farm or field, or for selecting the exact location for a road, building, or similar structure.

The 28 soil associations in the basin are described below: (Also see the General Soils Map)

Soil Associations of the Deep Loess Uplands

1. Fayette-Mount Carroll-Seaton Association - 0 - 12% slopes, well-drained fine silty soils.

2. Port Byron-Tama-Downs Association - 0 -12% slopes, well-drained dark colored fine silty soils.

These soils are moderately permeable silty soils formed in 5 to 20 feet of loess on uplands. Relief ranges from 10 to 50 feet. Slopes are long and smooth, 300-1,500 feet from summit to valley bottom or drainway: slope gradients are

mostly 1 - 12%. The landscape is mature. Closed depressions occur only in sinkholes in some Fayette soils. Runoff is collected in drainways and carried to streams such as Crooked and Winnebago Creeks which in turn drain to the Mississippi River. Runoff and sediment rates are high.

Soil Associations of the Pre-Wisconsin Age Erosional Surface

3. Ostrander-Maxfield-Klinger Association - 0 - 12% slopes, well-drained, moderately permeable soils formed in loamy till, poorly drained, moderately permeable silty soils underlain by firm slowly permeable loam glacial till, and well-drained, moderately permeable loamy soils moderately deep to sand.

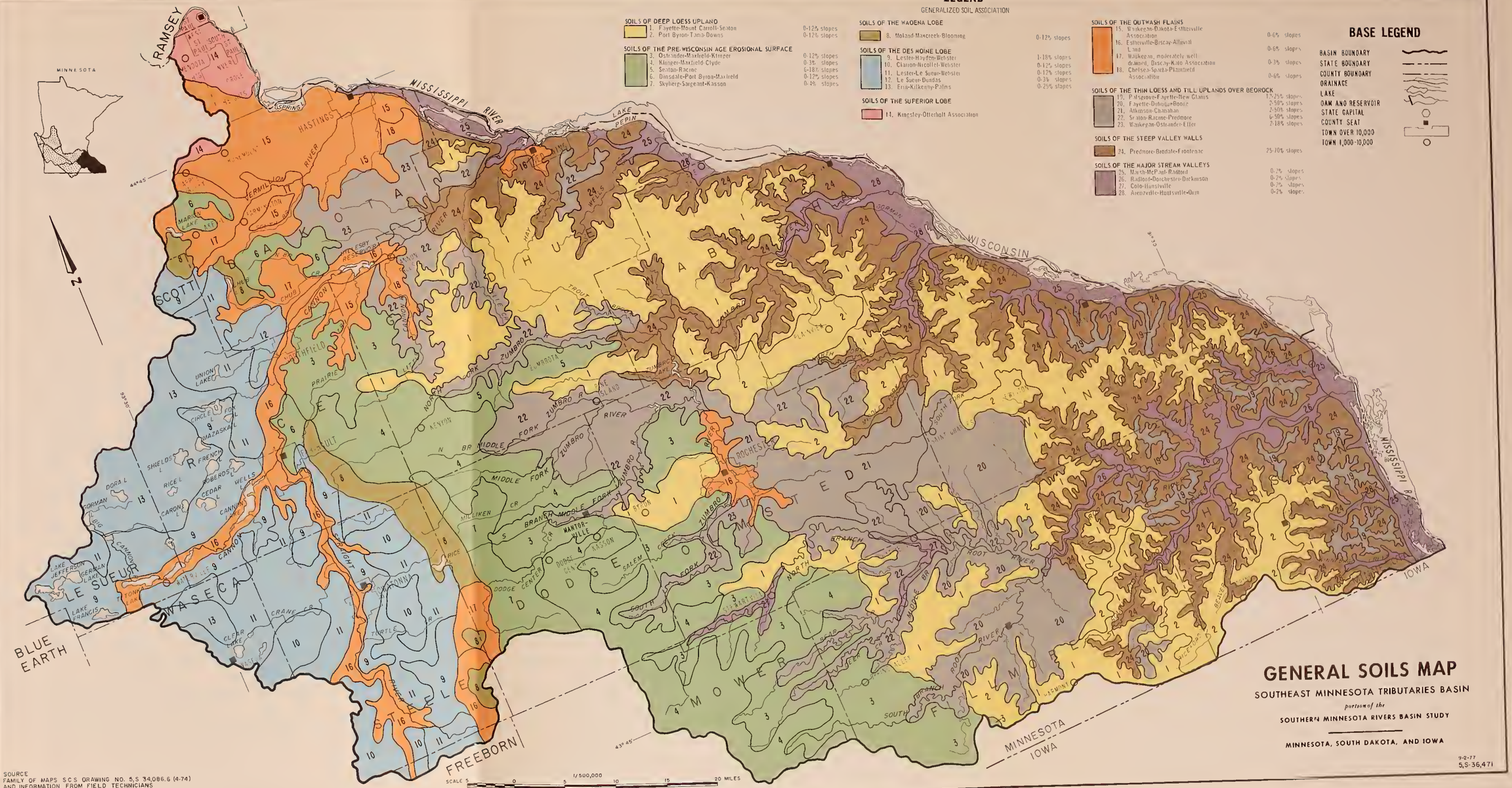
4. Klinger-Maxfield-Clyde Association - 0 - 3% slopes, moderately well, poorly drained, and very poorly drained prairie soils formed in silty sediments over slowly permeable loamy glacial till.

5. Seaton-Racine Association - 6 - 18% slopes - Well-drained silty and well-drained loamy moderately permeable soils.

6. Dinsdale - Port Byron - Maxfield Association - 0 - 12% slopes - well-drained silty soils underlain by firm, slowly permeable, loam glacial till, well-drained moderately permeable silty soils, and poorly drained silty soils underlain by slowly permeable loamy glacial till.

7. Skyberg-Sargeant-Karson - 0 - 4% slopes, poorly to moderately well-drained, moderately slow to slowly permeable soils formed in firm glacial till.

These are soils formed from firm, slowly permeable, "old gray" loamy glacial till that has a moderately permeable silty or loamy mantle about 15 to 60 inches thick. Bedrock lies at depths of 5 to 200 feet. Slopes are moderately long - 300 to 1,000 feet or more in length from summit to harrow drainways. Relief is generally 10 to 50 feet. Slopes range from 1 to 18%. A high percentage of this landscape is poorly to very poorly drained due to the dense underlying till.


U S DEPARTMENT OF AGRICULTURE
LEGEND
GENERALIZED SOIL ASSOCIATION
SOILS OF DEEP LOESS UPLAND
1. Fayette-Mount Carroll-Seaton 0-12% slopes
2. Port Byron-Tama-Downs 0-12% slopes
SOILS OF THE PRE-WISCONSIN AGE EROSIONAL SURFACE
3. Ostrander-Maxfield-Kilmer 0-12% slopes
4. Kilmer-Maxfield-Clyde 0-3% slopes
5. Seaton-Racine 6-18% slopes
6. Dinsdale-Port Byron-Maxfield 0-12% slopes
7. Skyberg-Sargeant-Kasson 0-3% slopes
SOILS OF THE WADENA LOBE
8. Moland-Maxcreek-Blooming 0-12% slopes
SOILS OF THE DES MOINE LOBE
9. Lester-Hayden-Webster 1-18% slopes
10. Clarion-Nicollet-Webster 0-12% slopes
11. Lester-Le Sueur-Webster 0-12% slopes
12. Le Sueur-Dundas 0-3% slopes
13. Ensi-Kilkenny-Palms 0-25% slopes
SOILS OF THE SUPERIOR LOBE
14. Kingsley-Otterholt Association
SOILS OF THE OUTWASH PLAINS
15. Waukegan-Dakota-Estherville Association 0-6% slopes
16. Estherville-Biscay-Alluvial Land 0-6% slopes
17. Waukegan, moderately well-drained, Biscay-Kato Association 0-3% slopes
18. Chelsea-Spafa-Plainfield Association 0-6% slopes
SOILS OF THE THIN LOESS AND TILL UPLANDS OVER BEDROCK
19. Platteville-Fayette-New Glarus 12-25% slopes
20. Fayette-Dubuque-Boone 2-50% slopes
21. Atkinson-Chanahan 2-50% slopes
22. Seaton-Racine-Predmore 6-50% slopes
23. Waukegan-Ostrander-Eitzer 2-18% slopes
SOILS OF THE STEEP VALLEY WALLS
24. Predmore-Brodale-Frontenac 25-70% slopes
SOILS OF THE MAJOR STREAM VALLEYS
25. Marsh-McPaul-Radford 0-2% slopes
26. Radford-Dorchester-Dickinson 0-2% slopes
27. Colo-Hunsville 0-2% slopes
28. Arenzville-Huntsville-Orion 0-2% slopes
BASE LEGEND
BASIN BOUNDARY
STATE BOUNDARY
COUNTY BOUNDARY
DRAINAGE
LAKE
DAM AND RESERVOIR
STATE CAPITAL
COUNTY SEAT
TOWN OVER 10,000
TOWN 1,000-10,000
MINNESOTA
RAMSEY
WASHINGTON
DAKOTA
SCOTT
CARVER
HENNEPIN
WRIGHT
SHERBURNE
ANOKA
ISANTI
CHISAGO
PINE
KANABEC
MILLE LACS
AITKIN
CARLTON
HUBBARD
CASS
WADENA
TODD
MORRISON
BENTON
STEARNS
MEEKER
KANDIYOHI
CHIPPEWA
LAC QUI PARLE
YELLOW MEDICINE
LINCOLN
LYON
LINCOLN
MURRAY
COTTONWOOD
JACKSON
NOBLES
REDWOOD
BROWN
NICOLLET
LE SUEUR
WASECA
BLUE EARTH
FARIBAULT
MARTIN
WATONWAN
CHILDRESS
FREEBORN
DODGE
OLMSTED
WINONA
GOODHUE
WABASHA
MOWER
FILLMORE
HOUSTON
WISCONSIN
IOWA
MISSISSIPPI RIVER
MINNESOTA RIVER
LAKE PEPIN
SCALE 1/500,000
0 5 10 15 20 MILES
GENERAL SOILS MAP
SOUTHEAST MINNESOTA TRIBUTARIES BASIN
portion of the
SOUTHERN MINNESOTA RIVERS BASIN STUDY
MINNESOTA, SOUTH DAKOTA, AND IOWA
9-2-77
S,S-36,471
SOURCE
FAMILY OF MAPS SCS DRAWING NO. S,S 34,086.6 (4-74)
AND INFORMATION FROM FIELD TECHNICIANS
TRANSVERSE MERCATOR PROJECTION
USDA-SCS-LINCOLN, NEBR 1978

Soil Association of the Wadena Lobe

8. Moland-Maxcreek-Blooming Association - 0 -12% slopes - well-drained and poorly drained moderately permeable soils.

These soils are loamy soils formed in silt mantled "gray" loam till. Slope gradient is smooth and moderately short - 150 to 400 feet length from summit to drainway. Relief ranges from 20 to 50 feet. Closed depressions are few.

Soil Associations of the Des Moines Lobe

9. Lester-Hayden-Webster Association - 6 - 18% slopes - well-drained, and poorly drained, moderately permeable loamy soils.

10. Clarion-Nicollet-Webster Association - 0 -12% slopes. Well-, moderately well-, and poorly drained, moderately permeable loamy soils.

11. LeSueur-Lester-Association - 0 - 12% slopes - well-drained, moderately well-drained, and poorly drained, moderately permeable loamy soils.

12. LeSuer-Dundas Association - 0 - 6% slopes -moderately well-drained, moderately permeable loamy soils, and poorly drained, moderately slowly permeable loamy soils.

13. Erin-Kilkenny-Palms Association - 0 - 25% slopes - Well-drained, moderately slowly permeable clayey soils, and organic soils formed in reeds and sedges.

These soils are loamy and clayey soils formed in "gray" calcareous glacial till 5 - 200 feet thick. These soils of the western part of the watershed occupy a landscape consisting of a disordered arrangement of irregular shaped knolls and depressions. Slopes are generally short - 75 to 300 feet in length. Relief ranges from 10 to 80 feet. The deeper depressions contain lakes or organic deposits quite deep. Runoff is low due to the many natural storage basins throughout the landscape. Hydraulic energies are dissipated at the base of the short slopes.

Soil Association of the Superior Lobe

14. Kingsley-Otterholt Association - 2 - 40% slopes. Well-drained, moderately permeable loamy, and silty soils.

These soils of the extreme northwestern part of the basin are easily identified by the steep disordered landscape upon which they occur. Irregular shaped hills are intermingled with depressions of variable size and depth. The soils on the knolls and hills are formed in 5 - 50 feet or more of reddish brown cobbly sandy loam till and gravelly and sandy outwash deposits. These materials are covered with a thin discontinuous silty mantle up to 5 feet thick. The depressions consist of deep silty deposits. Relief ranges from 30 to 100 feet. There are no streams or man-made channels; runoff and sediment are trapped in many basins. Very little runoff and sediment leave the basin. Organic soils are rare and the deep depressions contain lakes. The soils have limited potential for cropland because of the high proportion of steep slopes.

Soil Associations of the Outwash Plains

15. Waukegan-Dakota-Estherville Association -0 - 6% slopes - well-drained silty and loamy soils, moderately deep to sand, and somewhat excessively drained soils, shallow to stratified sand and gravel.

16. Estherville-Biscay-Alluvial land - 0 - 6% slopes - somewhat excessively drained loamy soils, shallow to stratified sand and gravelly sand, poorly drained loamy soils, moderately deep to stratified gravel and sand and sandy alluvial soils.

17. Waukegan-Moderately well-drained variant Biscay-Kato Association - 0 - 3% slopes - moderately well-drained and poorly drained silty soils moderately deep to sand.

18. Chelsea-Sparta-Plainfield Association - 0 -6% slopes - excessively drained deep sandy soils underlain by sands containing thin loamy layers.

These are soils formed from materials deposited by melting of glacial ice or by streams carrying glacial meltwater.

The soils formed in silty, loamy or sandy deposits, underlain by sand or gravelly sand at depths of 1 to 4 feet. Relief is less than 20 feet and runoff and erosion are low during the frost-season. Some associations have wetness problems, but in most associations, potential productivity is limited by low to moderate available water capacity. These associations have moderate to rapid permeability of the soil, and rapid or very rapid permeability of the sandy or gravelly substratum.

Soil Associations of the Thin Loess and Glacial Till Uplands Less than 60 Inches Thick Over Bedrock

Most of these soils are moderately permeable.

19. Palsgrove-Fayette-New Gladus Association -12 - 25% slopes - well-drained fine silty soils, deep, moderately deep or shallow to clayey limestone residuum.

20. Fayette-Dubuque-Boone Association - 2 - 50% slopes - well-drained deep and moderately deep fine silty soils, to limestone bedrock, and excessively drained sandy soils shallow to sandstone.

21. Atkinson-Channahan Association - 2 - 50% slopes - excessively drained loamy prairie soils shallow to limestone bedrock, and well-drained loamy prairie - forest soils deep to limestone beckrock.

22. Seaton-Racine-Predmore Association - 12 - 50% slopes - well-drained deep silty soils, well-drained deep loamy soils formed in glacial till on uplands, well-drained loamy soils formed in loamy material and limestone fragments on steep valley walls, and poorly drained, deep silty soils on bottomlands.

23. Waukegan-Ostrander-Etter Association - 2 -18% slopes - well-drained silty soils moderately deep to sand, well-drained deep loamy glacial till soils, and well-drained loamy soils, moderately deep to sandstone.

Soil Association of the Steep Valley Walls

These are moderately permeable soils along streams and rivers.

24. Predmore-Brodale-Frontenac Association - 25 - 70% slopes - well-drained loamy soils formed in loamy material and limestone fragments, excessively drained loamy soils formed in loamy material and limestone fragments, and well-drained loamy soils moderately deep to loamy fragmental material.

Nearly Level Soils of the Major Stream Valleys

These are deep silty soils 5 - 10 or more feet thick.

25. Marsh-McPaul-Radford Association - Very poorly drained soils, formed under reeds and sedge vegetation, moderately well-drained, moderately dark colored silty soils, and somewhat poorly drained dark colored silty soils.

26. Radford-Dorchester-Dickinson Association -Somewhat poorly drained dark colored silty, soils, moderately well-drained light colored silty soils, and excessively drained loamy soils shallow to sand. Radford and Dorchester are on bottomlands and Dickinson is on terrace positions.

27. Colo-Huntsville Association - Deep, poorly moderately well, and well-drained dark colored silty soils.

28. Arenzville-Huntsville-Orion Association -Moderately well-drained light colored silty soils moderately deep to buried silty soils that are dark colored, and well-, moderately well-drained dark colored silty soils and poorly drained light colored silty soils.

Definition of soil depth terms used in soil descriptions.

Depth to Contrasting Soil

Very Shallow	Less than 10 inches deep
Shallow	10 to 20 inches deep
Moderately Deep	20 to 40 inches deep
Deep	More than 40 inches deep

Permeability

Inches/Hour	Class
0.06	Very Slow
0.06 to 0.20	Slow
0.20 to 0.63	Moderately Slow
0.63 to 2.00	Moderate
2.00 to 6.30	Moderately Rapid
6.30 to 20.00	Rapid
20.00	Very Rapid

Relationship of generalized textural terms used in description of the soils.

Soil Textural Classes

Texture	General
Sands)	
Loamy Sands)	Sandy
Sandy Loam)	
Fine Sandy Loam)	Loamy
Loam, clay loam)	
V. fi. sa. loam)	
Silt Loam)	Silty
Silty)	
Clay)	
Silty Clay)	Clayey
Clay)	

Soil Suitability and Interpretations

In preparing for continued growth in the SEMT basin, planners should be conscious of environmental concerns, increased demand for food production, and the development needs of the region. Based on soils, climate, and the needs of a growing population, maps have been developed for the basin showing prime agricultural, timberland, and green span areas.

Prime areas are those areas best suited for a particular use. Areas shown on the following series of maps should remain in those uses because they are important to the overall welfare of the people in the State and Nation. In areas of conflicting land use, it should be the responsibility of policymakers at the local level to determine the primary use of that land.

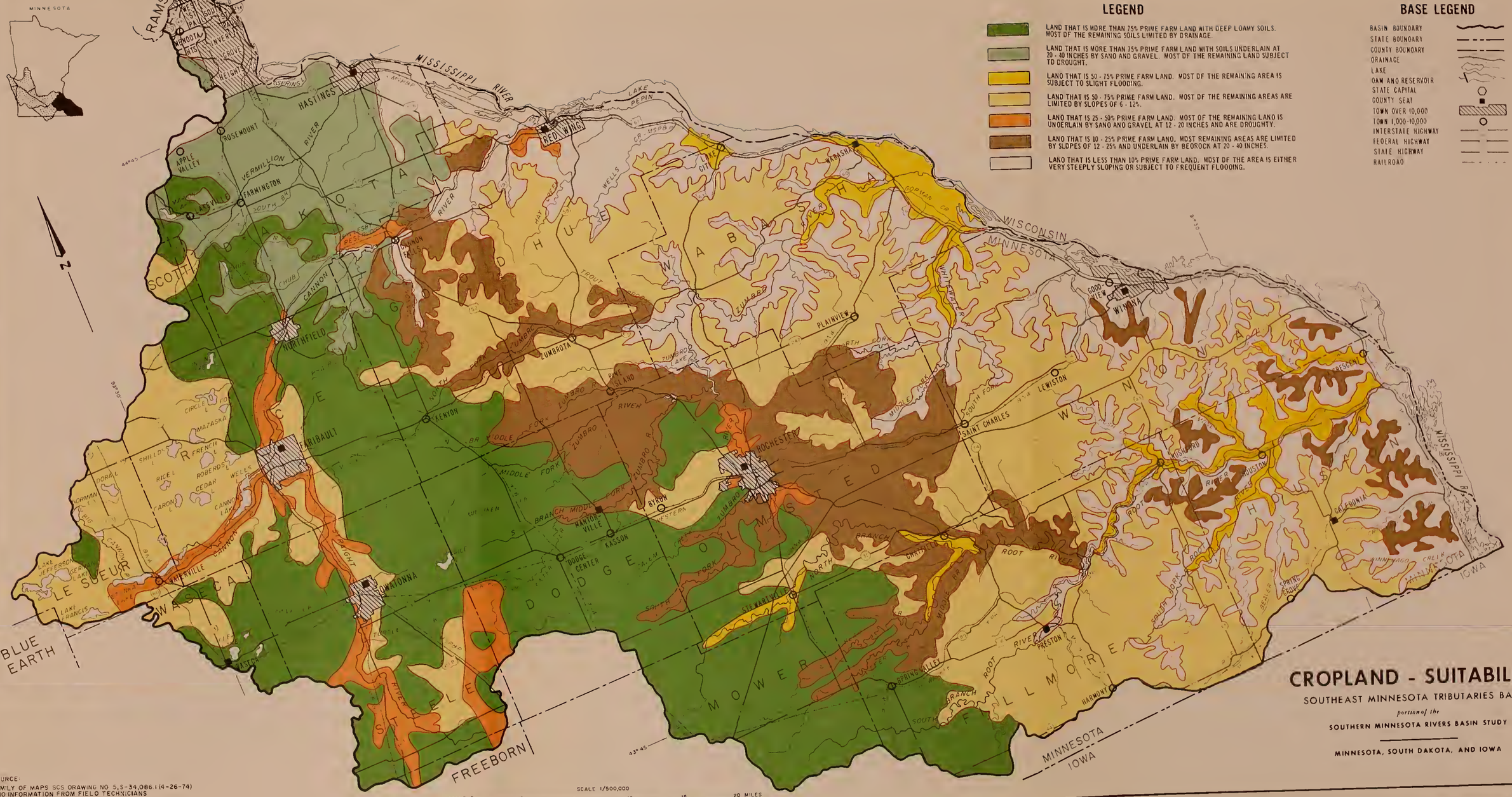
The following guidelines were used in the classification of cropland, woodland, and open space.

Prime Farmland

Prime farmland is land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops, and also available for these uses (the land could be cropland, pastureland, rangeland, forest land, or other land, but not urban built-up land or water). It has the soil quality, growing season, and moisture supply needed to economically produce sustained high yields of crops when treated and managed, including water management, according to modern farming methods.

In general, prime farmlands have an adequate and dependable moisture supply from precipitation or irrigation, a favorable temperature and growing season, acceptable acidity or alkalinity, acceptable salt and sodium content, and few or no rocks. They are permeable to water and air. Prime farmlands are not excessively erodible or saturated with water for a long period of time, and they either do not flood or are protected from flooding.

Approximately 1,777,800 acres of prime farmland are located within the basin. (See Cropland Suitability Map)



LEGEND

- LAND THAT IS MORE THAN 75% PRIME FARM LAND WITH DEEP LOAMY SOILS. MOST OF THE REMAINING SOILS LIMITED BY DRAINAGE.
- LAND THAT IS MORE THAN 75% PRIME FARM LAND WITH SOILS UNDERLAIN AT 20 - 40 INCHES BY SAND AND GRAVEL. MOST OF THE REMAINING LAND SUBJECT TO DROUGHT.
- LAND THAT IS 50 - 75% PRIME FARM LAND. MOST OF THE REMAINING AREA IS SUBJECT TO SLIGHT FLOODING.
- LAND THAT IS 50 - 75% PRIME FARM LAND. MOST OF THE REMAINING AREAS ARE LIMITED BY SLOPES OF 6 - 12%.
- LAND THAT IS 25 - 50% PRIME FARM LAND. MOST OF THE REMAINING LAND IS UNDERLAIN BY SAND AND GRAVEL AT 12 - 20 INCHES AND ARE DROUGHTY.
- LAND THAT IS 10 - 25% PRIME FARM LAND. MOST REMAINING AREAS ARE LIMITED BY SLOPES OF 12 - 25% AND UNDERLAIN BY BEDROCK AT 20 - 40 INCHES.
- LAND THAT IS LESS THAN 10% PRIME FARM LAND. MOST OF THE AREA IS EITHER VERY STEEPLY SLOPING OR SUBJECT TO FREQUENT FLOODING.

BASE LEGEND

- BASIN BOUNDARY
- STATE BOUNDARY
- COUNTY BOUNDARY
- DRAINAGE
- LAKE
- DAM AND RESERVOIR
- STATE CAPITAL
- COUNTY SEAT
- TOWN OVER 10,000
- TOWN 1,000-10,000
- INTERSTATE HIGHWAY
- FEDERAL HIGHWAY
- STATE HIGHWAY
- RAILROAD

CROPLAND - SUITABILITY

SOUTHEAST MINNESOTA TRIBUTARIES BASIN

portion of the

SOUTHERN MINNESOTA RIVERS BASIN STUDY

MINNESOTA, SOUTH DAKOTA, AND IOWA

SOURCE:
FAMILY OF MAPS SCS DRAWING NO. S,S-34,086.1 (4-26-74)
AND INFORMATION FROM FIELD TECHNICIANS
TRANSVERSE MERCATOR PROJECTION

S,S-36,482

USDA-SCS-LINCOLN, NEBR. 1978

Ratings for cropland are based on the potential and limitations of each soil association for producing corn and soybeans. A high level of management is assumed - management as defined in soil survey reports. Prime cropland as defined in this report, has the following characteristics:

1. Drainage

   A. Moderately well to well-drained.

   B. Poorly and very poorly drained mineral soils that can be artificially drained effectively.

2. Moisture storage capacity is more than six inches in five foot depth.

3. Reaction - medium acid to mildly calcareous.

4. Slope Gradient of less than seven percent.

5. Rock fragments larger than three inches across comprise less than ten percent of the surface.

6. Floods damaging to crops do not occur more than one year in five.

Map Code	Percent of Prime Farmland by Soil Associations
Green	Soil associations in which more than 75% of the land is prime farmland.
Lt. Green	Soil associations in which more than 75% of the land is prime farmland underlain by sand and gravel at 20 to 40 inches.
Ochre	Soil associations in which 50 to 75% of the land is prime farmland. Many areas are subject to slight flooding.
Yellow	Soil associations in which 50 to 75% of the land is prime farmland. Many areas are limited by slopes of six to 12 percent.
Orange	Soil associations in which 25 to 50% of the land is prime farmland. Most areas are underlain by sand and gravel at 12 to 20 inches and are droughty.

Map Code	Percent of Prime Farmland by Association
Brown	Soil associations in which ten to 25% of the land is prime farmland. Most areas are limited by slopes of 12 to 25% and underlain by bedrock at 20 to 40 inches.
Uncolored	Soil associations which are either very steeply sloping or subject to frequent flooding. Most of these areas are not suited for farmland.

Prime Timberland

Prime timberland is land that has soil capable of growing wood at the rate of 85-cubic feet or more/acre/year culmination of mean annual increment (site 3 or better) in natural stands and is not in urban or built-up land uses or water. Generally speaking, this is land currently in forest, but does not exclude qualifying lands that could realistically be returned to forest.

The definition of prime timberland considers only timber production. Identification of lands as prime timberland does not denote a single or dominant use. This designation does not preclude the use of these lands for other forest products and services, but only identified the most productive forest lands on which the Country depends for present and future wood needs. Neither does this constitute a designation of any land area to a specific land use. Such designations are the prerogative of responsible officials.

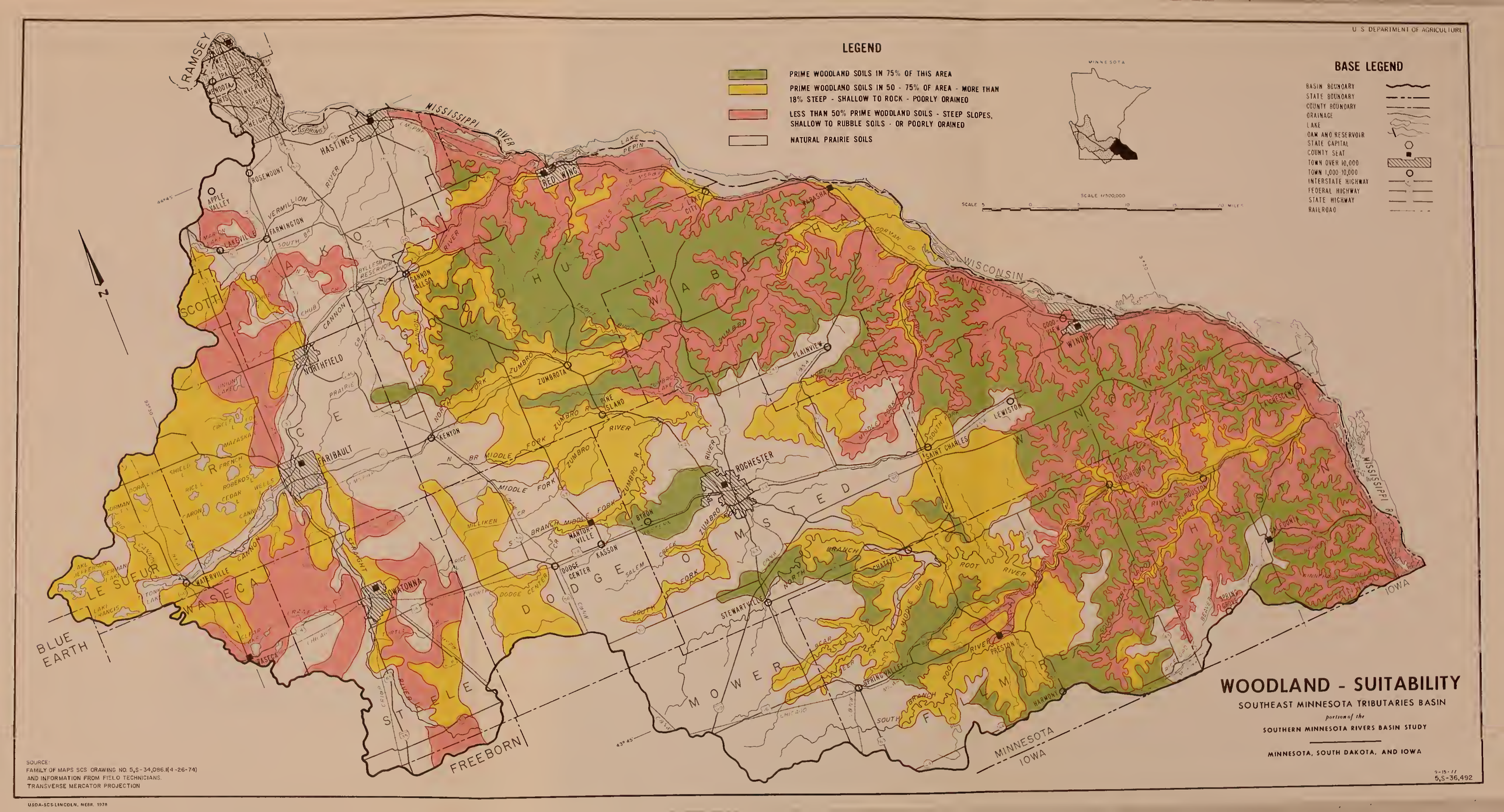
The physical criteria chosen for identifying prime woodland are those that accurately measure the soil's ability and the climatic conditions present to grow wood products. As a guide, the soils capable of growing the threshold rate generally have the following soil characteristics as defined in USDA Soil Taxonomy:

1. Soils that have an adequate moisture supply to sustain tree growth.

2. Soils that have a soil temperature regime that will sustain tree growth.

3. Soils that have adequate nutrient supply to permit establishment and sustain tree growth. Effective rooting depth generally is greater than 24 inches.

U S DEPARTMENT OF AGRICULTURE



WOODLAND - SUITABILITY

SOUTHEAST MINNESOTA TRIBUTARIES BASIN

portion of the

SOUTHERN MINNESOTA RIVERS BASIN STUDY

MINNESOTA, SOUTH DAKOTA, AND IOWA

SOURCE:
FAMILY OF MAPS SCS DRAWING NO. 5,S-34,086.1(4-26-74)
AND INFORMATION FROM FIELD TECHNICIANS.
TRANSVERSE MERCATOR PROJECTION

9-15-11
5,S-36,492

USDA-SCS-LINCOLN, NEBR. 1978

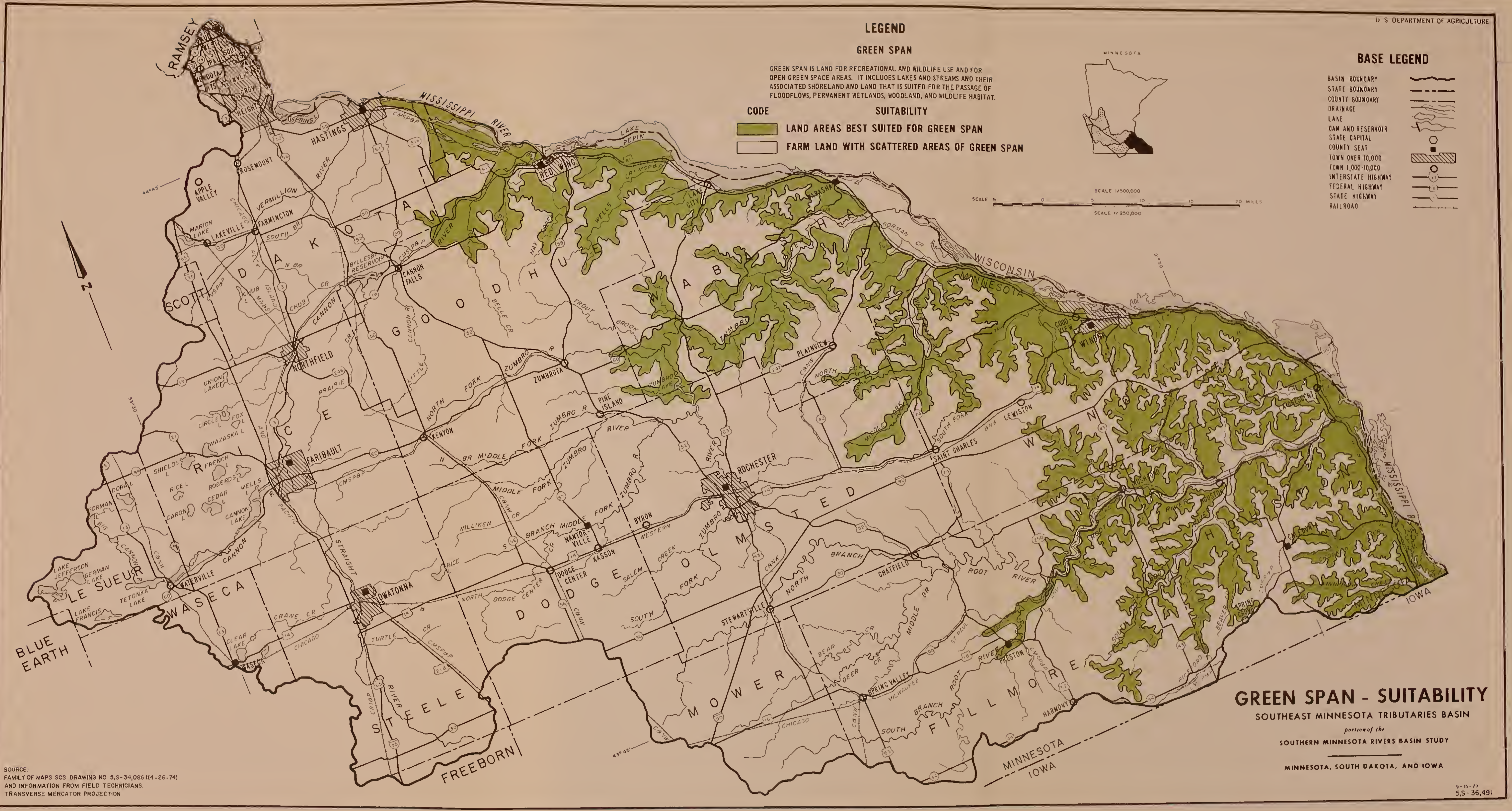
Map Code	Percent of Prime Timberland by Association
	(See Woodland Suitability Map)
Green	Soil associations in which more than 75% of the association consists of prime timberland soils. These soils are mostly in the eastern part of the watershed on the deep silty loess soils. Although most of this land has been cleared, narrow strips of woodland bordering drainways remain. Dominant bottom land hardwoods include elm, willow, silver and red maple, and black ash.
Yellow	Soil associations in which 50 to 75% of the association consists of prime timberland soils. The remainder of the soils are on steep slopes, (more than 18 percent), shallow to rock, poorly drained soils, and occur mostly in the western part of the watershed on the Des Moines lobe. (See Soil Association Map). All of this land has been cleared for agriculture except for scattered woodlots and woodland corridors on steep slopes along streams.
Pink	Soil associations in which less than 50% of the association consists of prime timberland soils. In the eastern part of the basin, this land is made up mostly of steep slopes (18 to 70%) on the valley walls along streams draining to the Mississippi River. The soils are underlain by fragmented limestone at less than 30 inches depth. All the valley wall soils are timbered except for the droughty soils on the south face of slopes along major streams. Oak, hickory, and aspen are the common forest cover. Timber production is low to moderate even on north and east facing slopes, because of shallow soil depth to rubble limestone, and high runoff rate. Woodlands in the western part of the basin grown on the small areas of poorly and very poorly drained soils on bottomland are included. The poorly drained soils support trees; reeds and sedges occupy the very poorly drained areas. Woodlands in the western part of the

Map Code	Percent of Prime Woodland by Association
	basin grown on the soils of the Des Moines lobe and are restricted to scattered woodlots of five to 80 acres in size. Most of this region has been cleared for cropland. Woodland potential is low because of the high proportion (20 to 50%) of poorly and very poorly drained soils. The well- and moderately well-drained soils have a high potential for woodland because they are deep and have high moisture storage capacity.
Uncolored	This area consists primarily of natural prairie soils. A few areas were wooded at the time of settlement, mostly around edges of lakes and along narrow corridors on both the steep valley walls and bottom lands. Some of these wooded areas persist, particularly along streams.

Greenspan

This includes woodland, wildlife habitat, wetland, and land subject to frequent flooding. Such areas provide desirable locations for recreation and wildlife use and for open green areas. These areas should be preserved for such use.

Map Code	Percent of Prime Greenspan by Association
Green	This land is made up almost entirely of valley walls along the Mississippi River and its tributaries. Slopes range from 18 to 70%. The soils are underlain by fragmented limestone at depths of less than 30 inches. Much of this land is wooded, except for parts of south facing valley walls along the major streams. Small areas of bottom land soils along the Mississippi River are included, as are small areas of nearly level to moderately



USDA-SCS-LINCOLN, NEBR 1976

Map Code	Percent of Prime Greenspan by Association
	steep (0 to 18% slopes) soils on narrow upland ridges. The valley walls are too steep and the soils too shallow for cropland. Woodland production is low because of the steep shallow soils. Few areas are suitable for pasture. This area provides good wildlife habitat.
Uncolored	Farmland with scattered areas of Greenspan. This land is level to sloping and is used primarily for agriculture. Most of these soils have high to moderate potential for cropland, woodland, and pasture. Wildlife habitat is good near streams.